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REPORT

OF THE

SECRETARY OF AGRICULTURE.

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REPORT

OF THE

SECRETARY OF AGRICULTURE.

Mr. President:

I respectfully present my Eleventh Annual Report of the work of the Department of Agriculture for the past year.

It has been a year of untoward conditions requiring all the industry and skill of the farmers to grow an average crop. They have struggled not only with an erratic season but with a scarcity of help in all the States and Territories of the Union.

REVIEW OF PRODUCTION.

AVERAGE CROPS AND HIGHEST INCOME.

Such a year as 1907 has been, with its hard winter, summer weather in March, and late cold spring, gives exceptional emphasis to the wisdom of this Department's policy of diversifying farm products and of establishing new crops. A general crop failure in a field as large as the chief part of the Temperate Zone of a continent must be a rare occurrence.

No general crop failure afflicts the farmer this year, not even within small areas. The production of the farms, all things considered, is well up to the average of the previous five years in quantity, while its value to the farmer, as now appears at this annual day of reckoning, reaches a figure much above that of 1906, which by far exceeded any previous year's wealth production on farms.

Out of the farming operations of 1907, the railroads will get an average haul of freight, and foreign countries will take a heavy excess above home consumption. The farmer will have more to spend and more to invest than he ever before had out of his year's work.

DURUM WHEAT.

ITS INTRODUCTION.

When the Department of Agriculture brought durum wheat to this country from Russia and Africa during 1899 to 1902 the seed was sown that formed practically the entire foundation of the present crop of durum wheat. At a cost of $10,000 in the beginning, a crop worth $30,000,000 now grows in regions of low rainfall, where in the day of stock ranges the steer roamed on 20 acres to find his living. This crop has encroached on the home of the prairie dog and of the cactus. It has spread throughout a wide strip of country, extending from northern North Dakota to southeastern New Mexico and northwestern Texas. It is a common crop in Montana and Idaho and in parts of Washington, Oregon, and Utah.

INDUSTRIAL USES.

This variety of wheat has entered into home industries. To a considerable extent it is mixed with other wheat in making flour for bread. It is promoting the manufacture of macaroni and kindred paste products in this country and is prepared as a breakfast food. It is the grain through which the desert feeds the cities of the east at home and abroad.

LARGE EXPORTS.

As an export crop durum wheat has become prominent. In 1905 Europe took nearly 10,000,000 of the 20,000,000 bushels produced; in 1906 about 20,000,000 bushels of the crop of that year.

Last year two-thirds of the exports went to Mediterranean countries. The former sheep and cattle ranges sent macaroni material to Marseille, Naples, and Venice; to Greece, Spain, and the countries of western Europe; and even to the old homes of durum wheat—northern Africa and Russia. Shipments of this wheat were made to 43 ports in Europe and Africa named in trade reports of the collectors of customs, and to other ports unnamed.

VALUE IS OVER TWICE THE COST OF THE DEPARTMENT.

With an average production of about 15 bushels per acre, durum wheat this year covered an area of over 3,000,000 acres, many of them valueless for agricultural purposes before the advent of this new crop. Its value to the farmer is over twice the entire cost of the Department of Agriculture during the current fiscal year, including the Weather Bureau, the costly meat inspection, and the Forest Service.

BEET SUGAR.

RAPID INCREASE.

The beet-sugar industry in this country had not advanced beyond experiment nor given promise of prominence until about 1888. Since that year it has rapidly grown, under aid and encouragement from the Department of Agriculture and the experiment stations and with favorable legislation by Congress and several State legislatures.

About 560 short tons of beet sugar were made yearly from 1879 to 1887; in 1891 the quantity was 6,000 short tons; in 1892, 13,460 short tons; in 1893, 22,344 short tons; in 1897, 45,246 short tons; in 1899, 81,729 short tons; in 1901, 184,606 short tons; in 1903, 240,604 short tons; in 1906, 483,000 short tons; and in 1907, 500,000 short tons.

ECONOMIC VALUE.

As an acquisition to agriculture much may be said in favor of growing sugar beets for the factory. Tillage must be of the best and the soil fertile. The pulp of the beets, after the extraction of the sugar, is relished by live stock. The crop is grown under factory-contract conditions, and the farmer knows upon what he may depend for profit.

FACTORIES AND LAND VALUES.

Sugar factories occupy a belt across the continent in the sugar-beet zone and a belt from Washington to Arizona along the Pacific coast. From the easternmost factory in western New York they extend through Ohio, Michigan, Illinois, Wisconsin, Minnesota, Kansas, Nebraska, Montana, Colorado, Utah, and Idaho; and from eastern Washington through Oregon and California to southern California and Arizona.

In 16 States there were 64 factories in 1906, with a capacity of working 49,500 tons of beets daily. Factories with more than three-fifths of this capacity are situated in the Western Division of States, and in that region this new crop has so well established itself and the growing of sugar beets has proved to be so remunerative that sugar-beet farms of the medium sort increased in value $42.49 per acre from 1900 to 1905, as determined by special investigation by the Department of Agriculture, or from $99.47 per acre in 1900 to $141.96 in 1905.

VALUE OF PRODUCT AND CAPITAL.

To the fostering of this industry by Nation and States, to the instruction provided by the Department of Agriculture, by experiment stations, and by agricultural colleges, it has responded by increasing the value of its production 543 per cent in nine years. The factory value of the refined sugar made in 1899 was $7,000,000, and in 1907, $45,000,000. More than $60,000,000 is now the value of the beet-sugar farms and factories.

One-third of the value of the beet sugar made this year would be enough to pay the cost of the Department of Agriculture during the current fiscal year and the National expense of the sixty experiment stations of contiguous United States when they shall have received the ultimate appropriation of the Adams Act.

ALFALFA.

Alfalfa, that extraordinary plant for producing wealth and doing wonders to farms, is occupying an important place in the plans of the Department of Agriculture, the experiment stations, and the agricultural colleges. Through their efforts largely it has rapidly gained success in cultivation throughout a vast area. The value of the crop as hay this year is supposed to be $100,000,000, and if the plans and efforts now under way to promote its extension receive a reasonable reward the value of the future crop will be several times the present amount.

This forage plant is a chemical laboratory in which nitrogen is taken from the air. It is a soil improver of the highest merit. As a flesh-forming feed for growing live stock, and as a milk and egg producer, it is unexcelled by any plant of large production.

It grows 2½ tons of hay to the acre as an average for the whole country where it is grown, or twice the average for all kinds of hay, and, besides this, is more nutritious than other hays.

The cultivation of alfalfa has been pressing eastward until now it has established itself as far as the longitude of eastern Kansas, except in southern Texas. It is established in some areas still farther to the eastward—in spots in Arkansas, in southern Wisconsin, northern Illinois, and northern Indiana, in the limestone regions of Kentucky and Tennessee, and in the southeastern corner of Michigan.

This plant is semi-established in Minnesota, Iowa, Missouri, and Ohio, and is making its way in Illinois and Indiana. Elsewhere the growing of this plant is mostly experimental, but with promise of success.

Further extension of alfalfa growing on large areas, by means of instruction by the Department of Agriculture, the experiment stations, and the agricultural colleges, is a prize that will be worth hundreds of millions of dollars yearly; and it will be won. What has already been secured aided in the rescue of the farm production of this year from the disasters of the weather.

IRRIGATION.

Among the large efforts that have the effect of giving steadiness to the agricultural production of the Nation at times of threatened adversity is irrigation. This is almost entirely confined to the arid and semiarid regions west of the one hundredth meridian and to the rice coast of the Gulf of Mexico in Texas and Louisiana, but will move eastward as its value is learned.

The area now under irrigation is 11,000,000 acres, or a surface equal to the improved farm land of Georgia, or Virginia, or Michigan, or equal to one-third of the cotton area.

At the census average income per acre, with allowance for subsequent increase of price of products, the value of the crops raised on irrigated land this year would appear to be worth at least $175,000,000, an increase of 75 per cent over the value of 1899.

In 1908 an additional area of 5,000,000 acres will be under ditch and ready for settlement. When this additional area is settled, the total will be 16,000,000 acres. If the new area were at once productive, the irrigated crops of 1908, at the price of 1907, would be worth $250,000,000, or more, and would support a population of over 1,000,000 persons.

SUMMARY OF CROP INTRODUCTIONS AND EXTENSIONS.

The foregoing striking features of the results of crop introduction and extension within the last few years are some of the illustrations of the wisdom of the great movement of the Department of Agriculture, of the experiment stations, and of the agricultural colleges, to fortify and buttress the agriculture of the Nation against misfortune, and to give to it a sort of insurance by multiplying the sources of success. This policy has done much to keep the production of 1907 not only from disaster, but, all things considered, actually to keep it up to an average of recent years.

VALUE OF THE DEPARTMENT'S WORK.

It is difficult to express in dollars the value of the work of the Department of Agriculture to farmers, and therefore to the Nation, but an attempt to do so was made last winter for the Committee of the House of Representatives on Expenditures in the Department of Agriculture, which made a total of $232,000,000.

Fundamentally the work of the Department is concerned with the production of wealth, as by increasing a crop yield per acre by plant breeding; and the preservation of wealth, as by suppressing insect and fungous pests; and with enabling farmers to make a fair sale of their products, as by promoting cooperative selling or by giving to the public information of the size of a crop in order that demand may be fairly adjusted to supply.

CHIEF CROPS.

CORN.

Four-fifths of the world's production of corn, as nearly as can be determined, grows in the United States, and in the world's international trade in corn this country contributes one-third to one-half of the exports, not including the products of corn-fed animals.

FACTOR IN NATIONAL PROSPERITY.—Corn is the chief of crops and exceeds every other prominent agricultural factor of national prosperity. It is a human food, and more especially a live-stock feed, with striking results. It is one of the great motive powers in the food of an energetic age. The starch of corn becomes the fat of the hog and the "finish" of the steer. No meat products are so much in demand in international trade as animal fats and oils. The value of these is more than one-half of the value of all exports of meat animals and packing-house products from this country. It is from four-fifths to nine-tenths of the value of these exports to Germany, to Italy, and to Norway and Sweden; and from two-thirds to four-fifths of these exports to France, and nine-tenths of these exports to Austria-Hungary, Denmark, and the Netherlands.

Fears of a failure or a large degree of failure of the corn crop this year diminished after midsummer and at last the harvest secured 2,553,732,000 bushels, a production that is almost exactly the average of the crops of the preceding five years. There have been three larger corn crops—those of 1899, 1905, and 1906.

ITS FABULOUS VALUE.—In value the corn crop of this year is much above the high-water mark of 1906. On the assumption that the crop will be sold by farmers at an average price not below the present one, its value is estimated to be $1,350,000,000, or 26 per cent above the average value of the previous five crops. Four crops before had exceeded one billion dollars in value.

The farm value of the corn crop of eight such years as 1907 would pay for duplicating every mile of steam railroads in the United States and pay for their costly terminals, rolling stock, and all property. In thirteen years it would replace the present banking power of this country in banking capital, surplus, deposits, and circulation, and in seventeen years it would replace the banking power of the world.

HAY.

Apparently the hay crop this year is more valuable than the cotton crop. On account of the varieties and qualities of hay its average price is difficult to determine without reports from crop correspondents. The computed value of the 61,420,000 tons of the crop is $660,000,000. The tonnage has been exceeded several times, but the value is $65,000,000 above the highest previous value, that of 1906. Compared with the average of the preceding five years, the quantity of the hay crop of this year is 2½ per cent higher and the value is 20 per cent higher.

COTTON.

If the cotton crop of this year does not eventually occupy second place in value instead of hay in the final estimates of the Department, if seed be included, it certainly has third place, even without seed.

The farm value of the 1907 crop of cotton and its seed is estimated to be from $650,000,000 to $675,000,000. The commercial expectations are that the crop will be found to be the third one in size ever raised, and perceptibly larger than the average crop of the previous five years. Its farm value is probably a little below that of last year's crop. Otherwise it will be the most valuable cotton crop ever raised in this country and 7 per cent above the average farm value of the crops of the previous five years.

SUFFICIENT FOR THE WORLD'S NEEDS.—The year was a trying one to cotton from planting time to nearly the end of the summer, but even under adverse conditions a crop has been produced that will be sufficient, with the surplus of last year, to meet the requirements of spinners until the next harvest.

The fears of a cotton famine that followed the low production of this country in 1901 have not been justified, and in the meantime efforts to make European spinners partly independent of the Upland cotton of the South by aiding the growing of "colonial" cotton have not made themselves felt.

Outside of the British East Indies, the production of cotton in the British colonies, possessions, and protectorates was 7,553 bales of 500 pounds gross weight in 1904 and 10,016 bales in 1905. In the French colonies, except French India and Indo-China, 400 bales were produced in 1904; in the German colonies, 1,500 bales in 1905.

LOW COST OF TRANSPORTATION.—Among the strong points of advantage possessed by this country's cotton is the low cost of transportation to market. Recent investigations by this Department indicate that the average cost of transporting cotton per 100 pounds from farm to local shipping point is about 16 cents; from local shipping point to seaport, about 40 cents; and from seaport to the United Kingdom, about 32 cents; the total being only 88 cents per 100 pounds, or less than a cent a pound.

WHEAT.

Wheat, the fourth crop of the year in value, is deficient in quantity by 5 per cent when compared with the average crop of the preceding five years. The 625,576,000 bushels produced will be enough for a large per capita consumption, with a remnant of many millions of bushels for export, although not as many as usual. During the last five years the wheat exports, including flour, have averaged 122,411,110 bushels, and during that period 18.6 per cent of the crops was exported.

Although wheat is 5 per cent in quantity below the average crop of five years preceding, it is 5½ per cent above the average value of these crops, or a little over $500,000.000. The crops of three years, 1901, 1902, and 1905, had a slightly higher value than this one.

OATS.

The only large crop to which a great degree of failure attaches this year is oats. Only 741,521,000 bushels were harvested and these were of low quality. In number of bushels this is the tenth oats crop ever grown in this country, and it is 19 per cent below the average crop of the previous five years.

In value the story is different. Contrasted with the loss of 19 per cent in quantity is a gain of 26 per cent in value in comparison with the five-year average; so that this year's crop is worth $360,000,000, or much more than the most valuable oats crop heretofore produced.

POTATOES.

The sixth crop in value is potatoes—292,427,000 bushels, worth $190,000,000. Three potato crops have exceeded this one in size—those of 1895, 1904, and 1906—but it is 2 per cent above the average of the previous five years. Its value is 26 per cent above the five-year average.

BARLEY.

Barley has pushed its way upward in production until it is now the seventh crop in value. The 147,192,000 bushels of this year are estimated to be worth $115,000,000. Only the crop of 1906 was larger, and the crop of 1907 is 2 per cent above the average of the previous five years. The value of barley this year indicates an extraordinary situation, the price per bushel being about double what it was last year; hence the value of the crop is about 85 per cent above the average of the previous five years.

TOBACCO.

The tobacco crop has declined to 645,213,000 pounds this year and is smaller than the crops of many years. It is 11 per cent under the average of the preceding five years, yet the value is the highest ever reached, except in 1906, and is estimated to be $67,000,000, or 16 per cent above the five-year average.

SUGAR, MOLASSES, AND SIRUP.

As farm crops, sugar beets and sugar cane are valued herein as such, except that the cane products are taken into account if the cane is crushed on the farm. The large cane-sugar mill is classed with manufacturing instead of with agriculture; this is to preserve the census basis for comparison.

The farm value of the sugar beets in 1907 and of the sugar cane and sorghum cane and such molasses and sirup as were made on the farm is estimated to be $64,000,000. The sugar-beets value is slightly above the figure for 1906, and is 50 per cent above that for 1905, and twice the amount for either 1903 or 1904. The farm value of sugar cane, molasses, and sirup is estimated to be $33,500,000, which was exceeded only in 1904.

As a manufacturing industry.—The popular interest in this subject is so large that it is worth mentioning as a manufacturing industry. The raw cane-sugar mill production of 1907 is estimated at 389,000 short tons, with a factory value of $28,000,000, the year 1904 alone exceeding this amount. The estimate for refined beet sugar is 500,000 short tons, worth $45,000,000.

Both kinds of sugar add to 889,000 short tons, worth $73,000,000. When mill molasses and sirup and sorghum and maple products and beet pulp are added, the total value of the ultimate products of the sugar, molasses, and sirup industry (the refining of cane sugar not included) in 1907 is $95,000,000.

FLAXSEED.

The 25,420,000 bushels of flaxseed of this year's crop are worth about $26,000,000, the quantity being 5 per cent under and the value 3 per cent over the average of the previous five years. The crop of 1902 is the only one that exceeded this one in value.

RYE.

With a production of 31,566,000 bushels, or 4 per cent above the average of the five previous years, the rye crop has a value of $23,000,000, or 29 per cent above the five-year average. In three years, going back to 1891, the production has been greater, and the value has been higher in two years, 1867 and 1901.

RICE.

Rice is the twelfth crop in point of value this year and in both quantity and value is the record rice crop. The preliminary estimate is a production of 21,412,000 bushels of rough rice, or 963,540,000 pounds, an amount a little above the great crop of 1904 and 98 per cent above the average crop of the previous three years. This year's crop is worth $19,500,000 to the farmers, or 36 per cent above the three-year average.

The exports of domestic rice in the fiscal year following the crop year 1904 were 75,000,000 pounds of cleaned rice, 4,000,000 pounds in 1906, and 2,443,000 pounds in 1907. The imports of rice, less the foreign and domestic exports, were about 64,000,000 pounds yearly from 1900 to 1903, and about 62,000,000 pounds in 1904. After the crop of 1904 the tide turned and in 1905 there were net exports amounting to 41,000,000 pounds, followed the next year by net imports of 43,000,000 pounds, and in 1907 of 61,000,000 pounds. The only year before 1907 when the production was greater than the consumption was 1904, and the production in 1907 is greater than in that year. The Department of Agriculture has been helping the rice grower to get better varieties from the Orient, which will change imports into exports.

BUCKWHEAT.

Buckwheat was a crop of larger production before 1860 than it has been in subsequent years, but it has revived during the last half dozen years. The production in 1907 is 13,911,000 bushels, or 4.7 per cent below the average of the previous five years, and its value is $10,000,000, or 14 per cent above the five-year average.

HOPS.

The hop crop has lapsed somewhat from its position in 1905 and 1906. The production of 1907 is estimated at 48,330,000 pounds, or 4.6 per cent below the five-year average, while the value of the 1907 crop is placed at a little less than $5,000,000, or 29 per cent below the five-year average.

TOTAL OF CEREALS.

Upon consolidating the seven cereal crops and comparing the production of 1907 with the average of the preceding five years, a loss of

214,000,000 bushels is observed, or 5 per cent. That is, the average of the five years was 4,349,000,000 bushels, and the production in 1907 was 4,135,000,000 bushels. The oats crop was 175,000,000 bushels under the average, and wheat 32,000,000 bushels, while rice was 11,000,000 bushels above, and rye and barley a little above.

Regarding corn as at the average of production and excepting oats, the other cereals show a net reduction below the five-year average of only 18,000,000 bushels, and this in a total production, omitting oats, of 3,393,000,000 bushels, so that the percentage of the net reduction is only one-half of 1 per cent.

In total value the seven cereal crops make a new high record that is above that of 1906 by $296,000,000. The farm value of the cereals of this year is estimated to be $2,378,000,000, or 23 per cent above the average of the previous five years.

SUMMARY OF CROPS.

In the production of crops the year 1907 has been a good one to all of the people as well as to the farmers. It has averaged with the previous five years after a general balancing of gains and losses. A great fall in oats below the average and much smaller declines in wheat, tobacco, hops, flaxseed, and buckwheat have been counterbalanced, and more than that, by increases above the average in cotton, hay, barley, rye, rice, and potatoes. This means material commodities and not the value placed upon them.

No such high aggregate of crop values has ever before been reached by farmers as for the crops of 1907. In estimating these, little if any use is made of the high prices before the break in the latter part of October. The present indication is that every crop except hops will considerably, if not very much, exceed in value the average of the previous five years. Extremely large rates of gain are observed for corn, oats, barley, rye, hay, tobacco, potatoes, rice, and cotton seed, and the rates of gain would be notable in any ordinary year in the case of wheat, cotton lint, and buckwheat.

In the grand total income from his crops of this year the farmer finds himself in better financial condition than before. He reckons his income in ten figures and he is still improving his farm, buying bonds, lending to his neighbors, and putting his money into the vaults of banks.

TOTAL WEALTH PRODUCTION.

HIGHEST RECORD.

Wealth production on farms in 1907, as expressed in value, transcended the high record of 1906, which was itself much above the highest amount before reached. In arriving at the total the farm products of the year are estimated in value for every detail presented by the census and at that point in production at which they acquire commercial value.

The grand total for 1907 is $7,412,000,000. This is $657,000,000 above the value of 1906, $1,103,000,000 above that of 1905, $1,253,000,000 above that of 1904, $1,495,000,000 above that of 1903, and $2,695,000,000 above the census amount for 1899.

The value of the farm products of 1907 was 10 per cent greater than that of 1906, 17 per cent over 1905, 20 per cent over 1904, 25 per cent over 1903, and 57 per cent over 1899.

A simple series of index numbers shows the progressive movement of wealth production by the farmer. The value of the products in 1899 being taken at 100, the value for 1903 stands at 125, for 1904 at 131, for 1905 at 134, for 1906 at 143, and for 1907 at 157.

During the last nine years wealth estimated as above explained was created on farms to the fabulous amount of $53,000,000,000.

SEVERAL GROUPS OF PRODUCTS.

Besides the crops, there were farm dairy products in 1907 which nearly reached $800,000,000. The price of butter increased 4¾ cents a pound over 1906 and of milk three-fourths of a cent a gallon.

More than $600,000,000 must be regarded as the value of the poultry and eggs produced on farms in 1907. The amount may easily have been larger. This industry has advanced at such a rapid rate that no arithmetic can keep up with it. The farm price of eggs in 1899 was 11.15 cents per dozen as an average for the United States; in 1903, 12.37 cents; in 1904, 17.2 cents; in 1905, 18.7 cents; in 1906, 17 cents, and in 1907, 18.2 cents.

Dressed poultry in New York sold for 10.78 cents per pound wholesale in 1899, for 12.97 cents in 1903, for 12.57 cents in 1904, for 13.36 cents in 1905, for 13.2 cents in 1906, and for 14.9 cents in 1907.

The animals sold from farms and slaughtered on them in 1907 were worth about $1,270,000,000.

DAIRY, POULTRY, AND LIVE-STOCK COMPARISONS.

Dairy products are much more valuable than any crop except corn, and are equal to one-third of the value of all cereals.

The poultry products are worth more than the wheat and perhaps as much as the hay.

The live stock sold from farms and slaughtered on them is worth nearly twice as much as the cotton crop.

It is only by comparison that a glimmer of understanding can be given to such numbers as the foregoing. Enough is apparent, however, to make it plain that the farmer of the United States is in a business that counts for National welfare by providing the wherewithal on a scale of magnificence that defies the imagination to comprehend.

FOREIGN TRADE.

EXPORTS.

Food and fiber were provided in such enormous quantities in 1906 that a great National surplus went abroad to feed and clothe many millions in foreign countries. High prices helped to swell these exports as expressed in money, and for the first time in the history of the world a country exported agricultural commodities of home production to a value greater than $1,000,000,000.

In the year ending June 30, 1907, the domestic exports of farm products were valued at $1,055,000,000, or $79,000,000 above the high record of the previous year. Four-fifths of these were plant products,

and chief among these was cotton, with a port value of $482,000,000, an amount much above the highest value of any former year.

The exported grain and grain products were valued at $184,000,000, the unmanufactured tobacco at $33,000,000, the oil cake and oil-cake meal at $26,000,000, the vegetable oils at $20,000,000, and the fruits at $17,000,000. All were gains over 1906, except the item of grain and grain products.

Animals and animal products were exported to the value of $255,000,000, mostly composed of packing-house products, worth $203,000,000, or only $4,000,000 under the high-water mark of 1906. Exported live animals were valued at $41,000,000 and dairy products at $6,600,000.

EXPORT MOVEMENT MOSTLY SUSTAINED BY THE FARM.—The farm sustains most of the great export movement. If to the products that are fully agricultural are added those that are considerably so in combination with materials of other origin, and then are added the forest products and the commodities considerably composed of them, the remnant of the exports is but 28½ per cent of the total value of the record for 1907.

Cotton and its products are 29½ per cent of the total value of all exports; animals and animal products, 17 per cent; grain and grain products, 10½ per cent; all other exports sustained by agriculture, 6½ per cent; and the exports sustained by the forests are 8 per cent. Farm and forest together sustained 71½ per cent of the exports of 1907.

IMPORTS.

Agricultural products valued at $627,000,000 were imported in the fiscal year 1907, of which the plant products were $403,000,000, chief among these being sugar and molasses, valued at $94,000,000; coffee, $78,000,000; vegetable fibers, $62,000,000; fruits and tobacco, each valued at $26,000,000, and vegetable oils, with a value of $15,000,000.

Animals and their products were imported to the value of $224,000,000, with packing-house products, mostly hides and skins, valued at $96,000,000; silk valued at $71,000,000, wool at $42,000,000, and dairy products at $6,000,000.

FOREST PRODUCTS.

Never before 1907 were the year's exports of forest products so valuable as in this year. With an increase of $16,000,000 over 1906, the total of these exports ran up to $93,000,000, of which $52,000,000 was the value of lumber, $22,000,000 naval stores, and $18,000,000 timber.

On the other hand, the imported forest products were valued at $123,000,000, mostly composed of india rubber, valued at $59,000,000; lumber, valued at $21,000,000; gums, not including rubber, valued at $15,000,000; wood pulp at $6,000,000; and unsawed cabinet woods at $5,000,000. The total imports of forest products were valued at $26,000,000 above the total of 1906, which was the highest amount hitherto reached.

BALANCE OF TRADE.

The farmer is concerned in the Nation's balance of international trade, inasmuch as he provides the great bulk of the foreign credit

which other classes of persons draw upon in the contrary movement of credit against this country.

The balance of trade in farm products in favor of this country in 1907 was $444,000,000, an amount that has been exceeded in only four years—1898, 1899, 1901, and 1902. In all other products the trade of 1907 produced a balance of only $2,500,000 in favor of this country.

MOST OF THE FOREIGN CREDIT PROVIDED BY FARMERS.—In eighteen years beginning with 1890 the farmers have not failed to secure a balance of at least $193,000,000, the low amount of 1895. The great aggregate of the 18 balances in the trade in farm products is $6,500,000,000, while the trade in other commodities during the eighteen years resulted in a grand adverse balance of $456,000,000.

A great stream of wealth has constantly been sent from farms to foreign countries to offset the adverse balance of trade in commodities other than agricultural; to pay the ocean freight costs on imports conveyed in foreign-owned ships; and to pay the interest, dividends, and principal on investments in the United States by foreigners. It is the farmer who has sent credit to expatriated Americans; it is he who has provided the immigrant with millions to send every year to the loved ones in the old countries; and, if there is still any credit to dispose of, the farmer has provided the American traveler in foreign countries with his pocket money.

THE FARMER'S THANKSGIVING.

The farmer has received much for which to be thankful. During the first half of the year he was threatened with general crop failure throughout the length and breadth of the country east of the Rocky Mountains. The very last day was exhausted that could be withheld from crop growth and still leave an average harvest.

Every necessary day for the development of the corn crop was worth 20,000,000 bushels of corn. Cotton needed a longer time and offered to pay 30,000,000 pounds of lint for the favor of each day of growth during the full term. Wheat offered over 6,000,000 bushels a day, tobacco 7,000,000 pounds, potatoes 3,000,000 bushels, and beets 6,000,000 pounds of sugar.

The entire wealth production of the farms was at stake and was dependent on a crop-growing season of sufficient length, and every one of its days was worth $50,000,000 to the farmer and to the Nation.

At the end of the harvest the farmer has provided the country with commodities that are equal to the average of recent years in quantity and vastly more than are needed for National consumption. His labor and his knowledge have been rewarded with products the sum of whose value is $7,412,000,000.

The miner can not restore the mineral to the mine. With the farmer it is different. The primal forces and atoms of the universe are his. The sun shines and the rain falls and the farmer applies his art and science to inexhaustible resources, ever adding enormously to the country's wealth, capital, credit, and welfare.

WEATHER BUREAU.

The creation of a research observatory at Mount Weather, Va., and the gathering together of a highly trained staff of men for the study of meteorological problems marks an important epoch in the development of meteorological science in this country. One of the first re-

sults achieved by that staff was the sending of meteorological instruments, by means of aeroplanes, to a greater altitude than has hitherto been accomplished. On October 3, 1907, the world's record for high flights was exceeded. On that day eight kites, in tandem, carried the meteorograph to an altitude of 23,111 feet above sea level. Daily observations of upper-air conditions have been continued for over three months in succession, practically without interruption, and it is probable that this record will be maintained indefinitely in the future. The observations obtained in this manner are placed before the forecast official in Washington each night. The latter is thus informed of the vertical gradients of temperature and the direction of the wind for altitudes varying on the average from one-half mile to 2 miles. These facts are of great importance in the making of forecasts for the Middle Atlantic and New England States and for the elucidation of many problems of the upper air that hitherto it has been impossible to study.

WEATHER FORECASTS.

In the past forecasts of the weather, as is well known, have been based entirely upon the existing horizontal gradients of pressure and temperature at the surface of the earth. The formation of charts showing the distribution of temperature with increase of elevation above the earth's surface, which is now for the first time possible in our weather service, so graphically tells the story of the rise and fall of the thermal levels that the layman is able to comprehend their significance. It is apparent that when a comparatively deep stratum of abnormally warm or abnormally cold air persistently overlies a region the action of a moving cyclone or anticyclone on the weather experienced at the bottom of the atmosphere will be materially different from that which would be experienced were the upper air at a normal temperature.

The significance of these data from the view point of the forecaster is not yet fully understood, but certainly they present a fund of information that will be studied with profit by those whose duty it is to add to our limited knowledge of the science that must precede the art of weather forecasting.

The upper-air work at Mount Weather is thus described in detail because it is the one line of inquiry that at present holds out the greatest promise of immediate utility. The results already secured are deemed to be of such value that it is hoped means will be provided for the diligent prosecution of other lines of research work.

DESTRUCTION OF THE ADMINISTRATION BUILDING.

On the morning of October 23, 1907, the interior of the administration building at Mount Weather was discovered to be in flames. The fire spread so rapidly that the eight persons sleeping in the building that night barely escaped with their lives, two being seriously injured. It has been impossible to determine the origin of the fire. This building was used as an ordinary observing station such as is maintained at all of the various meteorological offices of the Bureau. It also contained the administrative offices and the kitchen, dining, sleeping, and general living rooms of the scientific staff.

When the structure is rebuilt it should be made entirely of fireproof material.

THE FORECAST SERVICE.

The forecasting service of the Weather Bureau continues to furnish useful information concerning the approach of untoward weather conditions, the occurrence of damaging floods in the rivers, and of severe storms on the Great Lakes and the seacoast. Within the last year or so the river and flood service has been strengthened in its weak spots and somewhat enlarged by bringing into the system rivers which previously had no service. As now constituted it embraces practically all of the great navigable rivers of the country and many others. In view of the general desire for the improvement of navigation on the larger rivers and the development of the resources of the country tributary thereto, a strong river service becomes more important than ever.

SEISMIC DISTURBANCES.

The seismic disturbances which have occurred since the San Francisco disaster have fully aroused the scientific world to the importance of systematically studying these natural phenomena.

Exact knowledge of the character and magnitude of the motion of the ground when subjected to earthquake action is of vital importance to those whose business it is to design and erect the high structures now so numerous in all of our great cities. Earthquake-proof construction must be required, especially in great structures, even in regions which may seem to be immune; for probably it is only a question of time when some readjustment of the earth's strata under long accumulating stresses may occur in seemingly the most stable regions and an earthquake of greater or less severity be precipitated thereby.

Already action has been taken looking to the systematic study of earthquake phenomena by the formation of a National Bureau of Seismology in Strasburg, Germany. This organization is international in character.

It is submitted that this important work, since it affects the welfare of all the people, should be encouraged by the National Government, and that the Weather Bureau should be authorized to inaugurate and maintain systematic seismological observations within the United States and its Territories.

THE SALTON SEA.

The drying up of the Salton Sea, which now occupies a depression in the desert region of southern California, affords an opportunity of determining experimentally the rate of evaporation in the arid regions of the Southwest. In ten or fifteen years the sea will have disappeared, and in a somewhat shorter period its waters will have become so saline that its rate of evaporation will no longer be normal or representative.

RAINFALL AND EVAPORATION.

The two great factors which determine the amount of water available for purposes of irrigation are rainfall and evaporation. The Weather Bureau collects data of rainfall for all parts of the country, but nothing is being done on the evaporation side of the problem. The demand for accurate information respecting the rate of evaporation is most pressing from hydraulic engineers who are called upon

to draw plans for the construction of water-storage reservoirs in the various parts of the country and under widely varying climatic conditions. In addition to the needs of the engineer, a knowledge of evaporation in different climates is recognized as an important factor in the economy of plant life. The agriculturist should have the advantage of the most accurate information obtainable as to the loss of water from the soil by this process.

Reservoirs already constructed by private persons have largely failed of their purpose by reason of a lack of knowledge of the amount of evaporation. The great irrigation projects now under way in the semiarid regions and those which may be planned in the future will be greatly benefited by the knowledge which is here sought.

The Weather Bureau, in cooperation with the United States Reclamation Service and the United States Geological Survey, should enter upon a research looking to a solution of the problem.

BUREAU OF ANIMAL INDUSTRY.

THE MEAT INSPECTION.

The Federal meat inspection has been greatly extended and improved under the new law of June 30, 1906, and is now on a higher plane than ever before. Public confidence, which was unsettled by the agitation of the previous year, has been restored. The important matters of sanitation of slaughtering and packing establishments, preparation of meats and products, use of chemicals, preservatives, etc., and prevention of fraudulent labeling are now controlled and regulated, whereas formerly the Department had no authority over them, but was practically confined to an inspection before and at the time of slaughter to determine the health of the animals. The interstate transportation of meats and meat food products is also now under control.

Naturally a very marked increase has occurred in this branch of the work, as compared with the preceding year. Inspection was conducted at 708 establishments in 186 cities and towns during the fiscal year 1907, whereas in 1906 the corresponding totals were 163 establishments and 58 cities and towns. The number of employees engaged on meat inspection July 1, 1906, was 981; on July 1, 1907, this force had been increased to 2,290.

The meat inspection covered 50,999,034 animals, practically all of which were inspected both before and after slaughter. Of these, 149,792 carcasses and 529,876 parts were condemned for disease or other cause. The cost of this inspection was $2,159,474.12. While, therefore, all of the $3,000,000 appropriated by Congress for this purpose was not expended, it should be borne in mind that the law was in full force but nine months of the fiscal year, and that the service was constantly expanding during the year. The rate of expenditure during the first half of the period was considerably below the normal requirements under the new law. By using in the marking of meats a metal stamp with special ink prepared by the Department, instead of the label formerly employed, a saving estimated at half a million dollars a year is being effected.

In addition to the veterinary inspection there is a subsequent inspection of the meats and products, consisting of an examination by experts in the curing of meats and a laboratory inspection to determine the bacteriological and chemical condition of the finished products. For carrying on this work laboratories have been established at New York, Chicago, East St. Louis, Kansas City, Omaha, and San Francisco. As a result of this inspection more than one hundred different varieties of products which had been in circulation prior to the new act were found to be in conflict with it. Since then, however, the examinations show that as a general rule the packing houses have been complying with the law in regard to preservatives and coloring matter, and also in regard to proper labeling.

The microscopic inspection for trichinæ, which has heretofore been applied to pork intended for export to countries requiring such inspection, has been discontinued. The experience of this country as well as of Germany has shown that under practical conditions a reliable inspection for trichinæ is not possible, as it is sometimes necessary to examine a carcass microscopically as many as twenty or thirty times before the parasites are found. Germany, while requiring our certificates of microscopic inspection, was not willing to accept them as conclusive, but reinspected all pork imported from the United States. As the inspection seemed to be of little or no benefit, but of considerable expense, it was stopped. The microscopic inspection for trichinæ has never been carried on or considered necessary for the protection of the American public, as thorough cooking or thorough curing kills the parasites, and it is not the custom of Americans to eat pork in a raw, uncured state.

As it is often difficult to determine just where to draw the line between what should be passed and what condemned in meat inspection, especially where carcasses are affected in some degree with tuberculosis, a commission of experts outside of the Department was appointed to consider and advise with regard to those portions of the Department's meat-inspection regulations relating to the disposal of carcasses affected with various diseases and abnormal conditions. This commission consisted of Dr. William H. Welch, professor of pathology, Johns Hopkins University, chairman; Dr. L. Hektoen, professor of pathology, University of Chicago; Dr. M. J. Rosenau, director of the hygienic laboratory, United States Public Health and Marine-Hospital Service; Dr. Joseph Hughes, president of the Chicago Veterinary College; Dr. V. A. Moore, professor of comparative pathology, Cornell University; Dr. Leonard Pearson, dean of the veterinary department of the University of Pennsylvania, and Dr. Charles Wardell Stiles, chief of the division of zoology, hygienic laboratory, United States Public Health and Marine-Hospital Service, secretary.

The report of the commission has been received and is being considered in the preparation of revised regulations. The general conclusion with regard to the portion of the regulations under consideration was that "if there be any general error in the regulation this is in favor of the public rather than in favor of the butchers and packers."

While the Federal inspection insures the wholesomeness of the product of establishments doing an interstate and export business, the Federal power can not reach the numerous small, local establish-

ments whose product is sold entirely within a State. Some of the worst conditions have been found at places of the latter kind, and the tendency of a strict inspection is to cause diseased and unfit animals to be sent to slaughterhouses having no inspection. If the public is to be fully protected, the Federal inspection must be supplemented by State and municipal inspection. An inspection such as is carried on in some places—consisting merely of an examination of meat as offered for sale in the market and the condemnation of any that may be tainted or spoiled—is not sufficient. The purchaser can usually detect spoiled meat. What is more important is a careful veterinary inspection of all carcasses at the time of slaughter, to exclude those which are diseased. There is great need for the States and municipalities to apply such an inspection at all places not under Federal supervision. In the meantime the Federal inspection label offers to the consumer a guaranty that the meat bearing it comes from healthy animals and has been prepared under sanitary conditions.

INSPECTION OF EXPORT ANIMALS.

The inspection of the Bureau of Animal Industry also extends to the export trade in live stock. Animals to the number of 536,291 were inspected for export, and 484,254 were again inspected on arrival at British ports by Bureau inspectors stationed there. Seven hundred and forty-one inspections were made before clearance of vessels carrying export animals, and they were required to conform to certain regulations as to space, fittings, attendants, feed, water, ventilation, etc. The losses of animals in transit were only about one-quarter of 1 per cent.

ERADICATION OF THE CATTLE TICK.

The progress made in the eradication of the cattle tick which transmits Texas fever demonstrates that the ultimate extermination of this costly pest is entirely practicable, if Congress and the State legislatures will provide the necessary means. The great benefit which will accrue to the cattle industry of the South, and incidentally to the country at large, from the success of this work will abundantly justify the necessary expense.

The work of tick eradication was not actively begun until July 1, 1906; yet as a result of work done to October 31, 1907, there have been, or will in the near future be, released from quarantine certain areas in Virginia, North Carolina, Georgia, Tennessee, Arkansas, Oklahoma, Texas, and California, amounting to approximately 60,000 square miles, and good headway has been made in still other areas. The work has been pursued in cooperation with State authorities in the States above named and in South Carolina, Alabama, and Louisiana. Complete returns to October 31 last show that during the first ten months of the present calendar year this work has included 2,307,934 inspections and 775,795 disinfections of cattle. Various approved methods for the eradication of ticks have been used, including pasture rotation and dipping, spraying, and handdressing with oil and oil emulsion.

CONTROL OF CONTAGIOUS DISEASES.

The number of cattle moved from the area quarantined for Texas fever to northern markets during the quarantine season of 1906 was

1,000,629, shipped in 36,213 cars. These cattle were all for immediate slaughter and were handled under the supervision and regulations of the Department. There were also inspected in the provisionally quarantined areas of Texas and Oklahoma 126,238 head of cattle, which were permitted to be moved north for purposes other than immediate slaughter. Supervision was exercised over 137,902 dippings in crude petroleum and over the cleaning and disinfection of 36,895 cars.

The prevalence of sheep scab has been considerably reduced, and since the close of the fiscal year the quarantine for this disease has been removed from Wyoming and Idaho, and it is expected that later it may be removed from Utah. Such headway has been made as to give hope that, with another year's work, the disease may also be eradicated from Colorado, New Mexico, and Arizona. The total number of inspections of sheep for scabies was 62,625,831 (including 68,264 goats inspected for scabies at slaughtering centers), and the total number of dippings was 12,133,466, of which 2,640,408 were redippings.

The eradication of cattle mange or scabies is being continued, but has been retarded in some localities by the removal of fences from the public domain in conformity with an act of Congress, and by conditions on the open range where cattle travel great distances and mingle without restraint, making it easy for disease to spread and difficult to enforce proper sanitary measures. Under these circumstances it was found necessary to adopt more stringent regulations for the suppression of the disease, and better results are expected. During the fiscal year 1907 there were 15,243,323 inspections of cattle for scabies and 466,623 dippings. It would be of great advantage in combating contagious diseases of live stock if the public-land laws were so amended as to permit the leasing and fencing of the public domain so that owners might have better control over their animals and the promiscuous mingling of stock be largely prevented.

Although the troublesome venereal disease of horses known as maladie du coït or dourine, which prevailed in several of the Western States, was stamped out a year or more ago, owing to the insidious character of this disease it was thought best to continue inspection in the previously affected territory to make sure that no trace of the contagion remained. Nearly 15,000 inspections were made during the fiscal year, and all suspected cases of which information was received were investigated, but without finding a single case of the disease. It therefore seems certain that as the result of diligent work for several years this disease has been completely eradicated and that there will be no recurrence of it unless the contagion is again introduced from abroad.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

A careful system of inspection and quarantine of imported animals is maintained in order to protect our domestic live stock from the contagion of destructive animal diseases which are found in other parts of the world. All animals offered for importation are required to be inspected, and certain kinds when coming from certain countries are required to be quarantined for a sufficient period to insure their freedom from contagion. Cattle are required to pass the tuberculin

test for tuberculosis. During the fiscal year 147,897 imported animals were inspected, and of these 1,448 were quarantined. Blood tests are made of animals whose origin is such as to make it at all probable that they carry in their blood the causative agent of surra, a destructive disease which prevails in the Orient. In an importation of 51 cattle from India 17 were found to harbor this micro-organism and were destroyed. It is fortunate that the disease was detected and that the affected animals were slaughtered before the contagion could be introduced into this country. The absolute prohibition of the importation of all species of animals likely to harbor the parasite, from the sections where the disease exists, seems the only safe plan.

TUBERCULOSIS INVESTIGATIONS.

Tuberculosis has continued to be the subject of special investigations by the Bureau of Animal Industry. Further work has confirmed the view that the location of tuberculous lesions in the body is quite independent of the point at which the infectious material enters, and that the frequency with which tuberculosis occurs as a lung disease justifies the conclusion that the lung is not always infected directly through the air.

The work of the year also demonstrated that the commonest mode for the discharge of tubercle bacilli from the bodies of tuberculous cows is with their feces, that about 40 per cent of the tuberculous cows that show no outward symptoms are expelling and scattering tubercle bacilli, and that tubercle bacilli passed with the feces of tuberculous cows are actively pathogenic. When it is borne in mind how frequently milk contains cow feces, and that the percentage of dairy cows known to be tuberculous is considerable, the facts presented seem to warrant the conclusion that tuberculous cows are responsible in a great measure for the prevalence of tuberculosis in the human family.

During the past year there has been considerable agitation in the District of Columbia with reference to the improvement of its milk supply. The Commissioners of the District appointed a committee or conference composed of scientists, physicians, veterinarians, milk producers and dealers, attorneys, and business men to consider methods for obtaining pure and wholesome milk and to advise as to proper legislation to that effect. In order to assist in this work, the Secretary of Agriculture, about April 1, directed the Bureau of Animal Industry to apply the tuberculin test to the herds of all dairymen who might request such action. In tests made by the Bureau and by the health department of the District of Columbia, covering 37 herds with 658 cattle, 18 per cent were found to be tuberculous. Some of the reacting animals had every appearance of being in good health, and several of this kind were removed to the Bureau Experiment Station, where it was found that they were discharging tubercle bacilli in great numbers and that their milk produced tuberculosis in guinea pigs.

The examination of sediment taken from the cream separators of public creameries throughout the country has demonstrated the presence of tubercle bacilli in about one-fourth of the samples. These creameries must be regarded as an important source of tubercular infection for the hogs and calves that are fed upon the separated milk that is returned to the farm from the creamery. State laws should

be enacted requiring the sterilization of all milk and other products before they are returned by the creamery to the farmer for use as food for live stock.

The length of time that tubercle bacilli will live and retain their virulence in butter under usual market conditions is also being made a subject of investigation, but the work has not proceeded far enough to give definite results.

For the past five years careful and extensive scientific studies have been made of the comparative characters of human, bovine, and avian tubercle bacilli, and the results have been published.

The immunization of cattle against tuberculosis is being investigated.

HOG CHOLERA INVESTIGATIONS.

Continued experiments with hog cholera have again demonstrated that the contagion consists of a virus which exists in the blood and other fluids of diseased animals, but which can pass through the finest filter, is invisible under the microscope, and therefore can not be isolated or discerned by any of the usual methods.

The method of immunizing hogs against cholera, to which reference was made in last year's report, has been tested much more extensively, and the results show quite clearly that a comparatively certain method of protecting hogs from this disease has been secured. Hogs that have recovered from the disease or that have been exposed without contracting it are injected with suitable amounts of virulent blood from diseased hogs, and thus their immunity is heightened. The blood serum of these immunes is then used in vaccinating the hogs which it is desired to protect. The method giving the best results is to inject blood from diseased hogs simultaneously with the immune serum. By this method of vaccination hogs are protected for three and a half months or more, while by the use of the serum alone the protection can not be expected to last longer than three weeks. The immunized hogs probably retain for several months their power to furnish a potent serum. The serum probably can not be used successfully as a curative agent unless administered within four days after actual infection has taken place.

In order that this method may be more extensively tested, it is expected to make arrangements for the State experiment stations to test serum which will be furnished to them by the Department. It is hoped that the practicability of this method for combating hog cholera may thus be determined within a short time.

OTHER PATHOLOGICAL WORK.

Rabies continues to prevail in many parts of the country. When requested the Bureau examines suspected cases and makes diagnoses. During the year 47 post-mortem examinations were made in the pathological laboratory, and in 27 cases (all dogs except two—a sheep and a cat) the diagnosis was positive. Twelve of the positive cases were from the District of Columbia, 6 from Virginia, 5 from Maryland, and 1 each from Maine, Wisconsin, North Carolina, and South Carolina. In addition, several cases were investigated at the Bureau Experiment Station, and some of the animals which had been bitten were kept under observation and the disease studied as it developed in them.

A disease of the bobwhite, somewhat similar to grouse disease in Great Britain, appeared in several sections of the country, and as it seemed to threaten extensive destruction to this popular game bird an investigation into its cause and nature was promptly undertaken, and a preliminary report was published to assist in combating it.

The importation of cattle from India, before mentioned, some of which were found to carry in their blood the minute parasite which is the specific cause of the disease known as surra, afforded an opportunity for a study of that disease. Much was learned of its character and of the remarkable periodical development of the living parasites within the blood of the affected animals.

Among other lines of work in progress is an investigation of swamp fever in horses in cooperation with the Minnesota Experiment Station. The results so far indicate a probability of obtaining a satisfactory treatment for the disease.

WORK ON ANIMAL PARASITES AND PARASITIC DISEASES.

In the first series of field experiments in connection with a study of the life history of the roundworms of sheep, with the view of determining if possible methods of preventing infection, a system has been worked out by which lambs may be raised free from hookworms and stomach worms, and the length of time during which infection persists in pastures under certain climatic conditions has been determined. This information has been published.

An investigation of the distribution of the gid parasite of sheep in Montana shows that it is widely prevalent there. A comparison is also being made between specimens of gid parasites of American and European origin, in order to determine whether the two are of the same or different species.

An investigation is in progress concerning the so-called "palisade worm" disease of horses, which occasions the loss of a large number of animals annually in Wyoming and neighboring States.

SHEEP DIPS.

Cresol dips and coal-tar creosote dips to be used in the official dipping of sheep for scabies have been added to the two classes of dips previously sanctioned for this purpose, namely, the lime-and-sulphur and tobacco-and-sulphur dips. A large number of proprietary substances belonging to these four classes have been submitted for examination, and permission has been granted for the use in official dipping of those which were found to conform to the prescribed standard.

DISTRIBUTION OF BLACKLEG VACCINE, TUBERCULIN, AND MALLEIN.

The distribution of vaccine to prevent blackleg in cattle has been continued with good results, about 1,250,000 doses having been prepared and distributed to stock raisers during the fiscal year. This disease is becoming much less of a menace to young cattle than it was some years ago, when the mortality without vaccination amounted to over 10 per cent in certain sections. It is evident that the vaccine in a few years has not only saved many animals to the breeder, but has gone far toward the eradication of blackleg from the pastures of the country.

Tuberculin and mallein, for the diagnosis of tuberculosis in cattle and glanders in horses, are furnished to official veterinarians and health officers. During the year 129,050 doses of tuberculin and 41,012 doses of mallein were prepared and sent out, more than half of the mallein being furnished to the War Department.

ANIMAL HUSBANDRY WORK.

Experimental work and investigations are being carried on by the Bureau of Animal Industry in connection with the breeding of horses, cattle, sheep, and poultry, besides some small animals, and in the feeding of hogs, cattle, and poultry, most of the work being in cooperation with State experiment stations.

HORSE BREEDING.

The work in the breeding of American carriage horses, in cooperation with the Colorado Experiment Station, is progressing satisfactorily. During the fiscal year 11 foals, the progeny of selected parents, were dropped—2 males and 9 females. No additional horses were purchased.

The work in breeding Morgan horses, which is being carried on in cooperation with the Vermont Experiment Station, has been greatly extended through the generosity of a public-spirited citizen of Vermont, who donated to the Department a farm of 400 acres near Middlebury, to be used in these operations. There were in the Vermont stud on July 1, 1907, 1 stallion, 9 brood mares, 1 two-year-old filly, 8 younger fillies, and 1 weanling colt.

SHEEP BREEDING.

There is great need of a breed of sheep suitable to the range conditions of the West, the requirements being for sheep that will yield a profitable clip of wool, produce good mutton lambs, and stand flocking in large numbers. It is believed possible to combine these characteristics in one breed, and with this idea in mind an experiment was begun in the fall of 1906 in cooperation with the Wyoming Experiment Station. Eighty-nine ewes and four rams have been purchased for foundation stock.

BREEDING MILKING SHORTHORNS.

Experiments in developing a milking strain of Shorthorn cattle have been begun in cooperation with the Minnesota Experiment Station and with nine Minnesota breeders, the latter having agreed to allow their herds to be used and to manage them according to instructions of the Department and the station.

BEEF PRODUCTION IN THE SOUTH.

Experiments in steer feeding under southern conditions have been conducted for the past three years in cooperation with the Alabama Experiment Station, and another experiment in the Tennessee valley (northern Alabama) is now in progress. The object of these experiments is to show what can be done under farming conditions in the way of improving the native cattle for beef purposes by means of proper feeds and the use of pure-bred bulls, and to make southern farmers familiar with the use of their by-products for meat production.

POULTRY BREEDING AND FEEDING.

The poultry investigations in cooperation with the Maine Experiment Station are being continued, the objects being to increase egg production and to compare the yields and welfare of hens when kept in flocks and inclosures of different sizes. From year to year the better laying hens are selected by their records in trap nests and mated with the sons of heavy layers. The results have shown that by the methods used hens with greater laying capacity can be obtained.

A poultry-feeding experiment was begun in the fall of 1906 at the Bureau quarantine station at Halethorp, Md., to determine the respective values of the moist mash, dry mash, and hopper methods of feeding. Further experiments will be conducted at the Bureau Experiment Station near Washington, D. C., which is a more favorable location and where a suitable equipment is now being built.

ANIMAL NUTRITION.

The experiments in animal nutrition with the respiration calorimeter, in cooperation with the Pennsylvania Experiment Station, during the fiscal year have consisted of a continuance of the investigations concerning the influence of age and individuality upon the metabolism of cattle, and eight additional experiments, together with a number of check tests to control the accuracy of the apparatus. A bulletin upon the energy value of red-clover hay has been prepared for publication.

At the beginning of the new fiscal year, July 1, 1907, the work in animal nutrition was materially enlarged by the addition of cooperative experiments in feeding beef cattle at the Missouri Experiment Station. A large number of steers are being fed to compare the results of feeding 2-year-olds and calves, and exhaustive investigations are planned in the feeding of steers from birth to maturity. Representatives of different lots and ages, with supplies of the feed used at the Missouri Experiment Station, will be sent to the Pennsylvania Experiment Station for tests in the respiration calorimeter.

CLASSIFICATION FOR AMERICAN CARRIAGE HORSES.

The Bureau of Animal Industry has been instrumental, by means of a cooperative arrangement with the American Association of Trotting Horse Breeders, in preparing a uniform classification for American carriage horses. The adoption of this classification at State fairs and similar gatherings is expected to aid materially in fixing a uniform type of horse and to enable the farmer to appreciate more the value of the horses raised by him and thus secure some of the large profits made by middlemen, who now buy cheaply from the farmers and after a few months of handling and finishing often sell at fancy prices.

WORK RELATING TO THE DAIRY INDUSTRY.

A large amount of work, both educational and research, has been accomplished in the Dairy Division of the Bureau of Animal Industry during the year.

SOUTHERN DAIRYING.

Considerable effort has been expended toward improving the dairy conditions of the South under a special appropriation made by Congress for this purpose. Nine men have been engaged in the work in seven States. The work has enlisted the attention and good will of the farmers. Assistance has been rendered in the remodeling of old barns and the building of new ones, the construction of silos, the selection and breeding of herds, and the keeping of records of feeds and of the products of the dairy herds. Local market conditions and the sources of the supplies that are brought into the South from outside territory have been investigated.

Many farmers have been induced to keep records of their herds, so as to show the cost of feed and the amount realized from the products both before and while carrying out the suggestions made for improved methods. Such records have been kept for 70 herds, comprising 1,606 cows. The results from 16 herds have been compiled for illustration and show an average increase of $3.75 in the monthly production of each cow. This is a striking example of the practical results to be obtained by the adoption of better dairy methods in the South.

The work has met with uniform favor. So encouraging have been the results of the Department's work that similar work is being taken up by some of the States. It is believed that after this special educational work has been well started the Department should withdraw and the States should continue it.

BUTTER INVESTIGATIONS.

Investigations to determine the cause of fishy flavor in butter are being continued and progress has been made, but a complete solution has not yet been reached. This trouble is the cause of heavy loss to the trade.

Experiments have also been made concerning the amount of acidity in cream and its effect upon the keeping quality of butter. Several thousand pounds of butter were made from cream having various degrees of acidity and the butter was stored at different temperatures to test its keeping qualities. It was found that pasteurized cream, churned sweet without starter, produced remarkably fine butter that kept without deterioration for weeks after it was taken out of storage. This was at such marked variance with the general views of butter makers that it has been deemed best to repeat the experiments during the coming year. If the findings of the past year are confirmed, almost a complete revolution in the methods of making butter from sweet cream seems likely to occur.

During the year an extremely simple and rapid method of determining the amount of moisture in butter and other products—a great need of the butter makers—was worked out by the Dairy Division. Application for patent has been made in such a way that the apparatus and method may be used by any person in the United States without payment of royalty.

LABORATORIES AT ALBERT LEA, MINN.

In the spring of 1907 laboratories for butter and cheese investigations were established at Albert Lea, Minn., in cooperation with the Minnesota Experiment Station. Bacteriological and chemical lab-

oratories have been built and equipped, and arrangements have been made for a large supply of milk to be used for experimental purposes.

CHEESE INVESTIGATIONS.

The cheese investigations consist of three general lines, namely, soft-cheese experiments in cooperation with the Storrs (Conn.) Experiment Station, Cheddar cheese investigations in cooperation with the Wisconsin Experiment Station, and Swiss cheese investigations at Albert Lea, Minn. The work on the Camembert type of cheese, which has been in progress for the last few years, has been practically completed, and a bulletin giving directions for making this kind of cheese was published during the year. At present a study is being made of the problems involved in the manufacture of Roquefort cheese. These experiments are intended to avoid the necessity of importing European cheese, as we have cheaper grasses and mill feeds than any other country.

IMPROVEMENT OF THE MILK SUPPLY.

Following the success of the milk and cream competitive exhibition in connection with the National Dairy Show at Chicago in 1906, similar contests have been held in other cities and have had a marked effect in the improvement of the milk supply.

A feature of the year's work was the investigation of the milk supply of Washington, D. C. Nine hundred and sixteen dairies and dairy herds, with 16,446 cows, were inspected and rated in accordance with a score card prepared by the Dairy Division. With few exceptions the conditions found were very unsatisfactory, the average score being only 45 out of a possible 100. This result may be considered as giving some indication of the quality and condition of the milk supply of the country, as it is believed that the conditions around Washington are no worse than those existing around other large cities.

The Department is taking an important part in the general movement for a better milk supply, and assistance in that direction has been rendered to a number of cities. Insanitary conditions of milk production and the prevalence of tuberculosis in dairy herds are two evils that should be overcome. Dairy products, which form a large part of our food supply, need special attention in order to insure wholesomeness. Is it the desire of Congress to supplement existing legislation by giving the Department authority to inspect all dairy cows and dairy establishments whose products are to enter interstate or foreign commerce, so as to exclude products of diseased cows and products prepared under insanitary conditions, according to the principle on which the meat inspection is based?

CREAMERY INVESTIGATIONS.

The economic features of the creamery business have received special attention during the past year. Reports were solicited from creameries with a view to giving them assistance in their methods of conducting the business. At the close of the year from 500 to 600 creameries were reporting monthly. A careful analysis of these reports shows a heavy loss to many creameries and to the farmers supplying them, owing to lax methods and the absence of system in keeping records. These losses are computed to be not less than $5,000,000

a year for the entire country. Whenever reports indicating defective work are received, letters are written pointing out the defects and suggesting remedies.

The market inspection of butter at Chicago and New York has been continued with a view to assisting creameries to improve the quality of their product. Large quantities of butter deficient in quality are found in these markets. When requested by the shipper, the experts of the Dairy Division examine a shipment on its arrival at market and send to him promptly a reliable report as to its condition and quality. If the butter is not of good quality, they state what the defects are and make suggestions for overcoming the trouble. This work has resulted in a general improvement in the quality of the butter received on the market and has thus enabled the creameries to obtain better prices.

OTHER DAIRY WORK.

Farmers and dairymen are being encouraged to keep records of their dairy herds. It is believed that if this practice were more generally adopted much pecuniary and other benefit would accrue to the owners of dairy cows.

The work of planning dairy buildings of various kinds has been continued. During the year 56 different plans have been drawn and 504 blueprints made and sent out.

A thorough and prolonged study of the problems connected with the secretion of milk has been undertaken in cooperation with the Missouri Experiment Station. Other work includes a study of pasteurization and other processes which may affect milk from a bacteriological and chemical standpoint.

The Dairy Division installed and conducted at the Jamestown Exposition what was termed a modern dairy plant, showing the equipment and methods for a small dairy farm and for a large city milk business. Literature was distributed and stereopticon lectures were given.

RENOVATED BUTTER INSPECTION.

The Dairy Division carries out the provisions of the law of 1902 respecting the inspection of renovated butter, also known as "process" butter. There was produced during the year 63,000,000 pounds of this product, at 49 factories. This production represents an increase of 15 per cent over the previous year.

BUREAU OF PLANT INDUSTRY.

The work of the Bureau of Plant Industry covers a wide field. The Bureau is striving to aid the farmer in protecting his crops from destructive diseases; it points out ways of improving crops by breeding and selection, as well as by better methods of tillage and better methods of management; it explores the world for new crops, and when these are found and introduced, it encourages and supports the efforts made in their production until new industries are established. The principal results secured during the year along these and other lines are briefly set forth under the following headings.

THE WORK OF THE PATHOLOGISTS.

During the year the pathologists of the Bureau have been called upon to undertake a number of new investigations and to continue important lines of work already under way.

ERADICATION OF PEAR BLIGHT.—It was pointed out in my last report how important work had been inaugurated on the Pacific coast with a view to preventing the destruction of the extensive pear orchards, valued at many millions of dollars. Pear blight has been and is devastating these orchards, and the Department, in cooperation with State authorities, has been working to check it. The systematic work undertaken in the matter of eradicating blight from the orchards through winter pruning has led to beneficial results. The progressive orchardists who have carried on the work thoroughly have succeeded in holding the disease in check and in securing a profitable crop of fruit from the treated orchards. In other cases, however, principally as the result of careless treatment or no treatment at all, many orchards have been destroyed. The work will be continued this coming season and every assistance possible given to those orchardists desirous of fighting the disease. As already indicated, the Department has had the hearty cooperation of the State experiment stations and other State authorities, who are fully alive to the importance and necessity of doing all within their power to aid the fruit growers of the respective States in which they are located.

CONTROL OF APPLE DISEASES.—Another line of work which has been carried on successfully during the past year has had for its object the control of apple diseases in the Ozark Mountain region. This section of the country is developing into a fine fruit region, and the value of the orchards is increasing yearly. Since the orchards have come into bearing, however, various serious diseases have appeared, and the vital question of how best to control these diseases has arisen. Some of the work started last year in Nebraska and localities in Missouri had to be discontinued on account of the destruction of the fruit by cold. In a considerable portion of the Ozark region, however, there was a good crop of fruit not injured by cold, and in these orchards the control of bitter rot, black rot, and the fruit blotch was again practically complete where the methods recommended by the Department were carried out, from 95 to 98 per cent being saved in the sprayed orchards. In all this work combination treatments have been made in order to prevent both diseases caused by fungi and injuries produced by insects. In this work the Bureau of Plant Industry is cooperating with the Bureau of Entomology.

PREVENTION OF FOLIAGE INJURY IN SPRAYING.—For a number of years it has been a problem with pathologists to find some successful way of treating the peach with fungicides in order not to injure the foliage. Some of the standard fungicides often cause complete defoliation. For this reason it has been found difficult to control a number of serious diseases affecting the peach by any of the ordinary treatments. This year it was discovered that a sulphur wash made by combining lime and sulphur, with no other heat than that produced by the slaking of the lime, gave a preparation which was not injurious to peach foliage and which prevented the scab and reduced peach rot to 10 per cent on the sprayed trees, whereas unsprayed trees had 75 per cent of the disease. This fungicide, further, completely prevented the leaf-spot fungi and produced no injury whatever, either to foliage or fruit. While this preparation has been previously used in winter when the trees were dormant, this is the first time it has been tried on trees in active growth, with the success as indicated.

Control of California peach blight.—Last year mention was made in this report of a very serious disease of the peach in California, popularly known there as "peach blight." Experiments were conducted during last fall and winter for the control of this disease, and, as the result of this work, it was found that the disease could be completely controlled by the use of standard Bordeaux mixture or lime and sulphur wash applied early in the fall, about the time of the first rains. The methods recommended by the Department were widely used in California the past season with complete success, and we have been reliably informed that the treatment has meant many millions of dollars to the peach industry of that State.

Study of crown gall diseases.—The pathologists in this Department and in some of the experiment stations have for a number of years had under investigation a disease of fruits commonly known as "crown gall." Heretofore no organism has been definitely proved to be the cause of this disease. The results of the Department's work the past season indicate that there are two types of the malady. One form, which occurs in apples, producing hard galls, appears to be noncontagious, while the other, the soft gall, which occurs occasionally on apples and is the common form on stone fruits, especially the peach and plum, is very contagious. Two of our pathologists working on a similar disease in another plant have isolated an organism which produces galls practically identical with the soft crown gall on the peach, plum, hop, and numerous other plants. This is an exceedingly important line of investigation and doubtless will pave the way for securing information which will be worth a great deal to the fruit interests of the country.

Cooperative work on forest diseases.—The great interest in all matters pertaining to the protection of our forests and forest trees has led to the further organization of work in the Bureau having for its object the special study of forest pathology. In order to carry out this work to the best advantage, cooperative arrangements have been made with the Forest Service to the end that the strictly pathological work is conducted by the Bureau of Plant Industry, while the practical application of laboratory discoveries is worked out and applied in the field by the forest experts.

NEW CROPS AND NEW INDUSTRIES.

The general policy of the Department, inaugurated several years ago, having for its object the development of home industries for the purpose of keeping money in the hands of our own people, has been followed during the year. Elsewhere in this report figures are given showing the immense amount of cash we still send abroad for things that we might grow at home. During the year experts of the Bureau of Plant Industry have been engaged in exploring foreign countries, securing new plants worthy of trial here.

Oriental plant explorations.—China has proved a fruitful field for this work, and an explorer has been kept there constantly during the year. His work has taken him through the little-known regions of southern Siberia, the border of Manchuria, the excessively dry mountains west of Pekin, and through the fertile country between Pekin and Hankau. This explorer has sent to this country over a thousand living seed and plant specimens for trial. Among these are promising blackberries and currants from northern Korea; a

north Manchurian apple; a collection of 24 named pears from north China; several bush cherries and plums and peaches from northern Siberia—perhaps the very northern limit of peach culture in the Orient; drought-resistant alfalfas; dry-land rices; staple foods of the native Manchurians, but unknown to us, from regions where the climate is similar to that of the Dakotas; and a cherry noted for remarkable earliness, ripening its fruit in mid-April in northern California. Besides these, the explorer has sent in a large number of ornamental plants which our nurserymen have been for some time anxious to secure, because of the unusual hardiness of these north China species.

New alfalfas and clovers.—During the year an explorer was sent out for the purpose of securing forage crops and was still abroad when my last report was submitted. He has returned with seeds of the yellow-flowered Siberian alfalfa, and these seeds have grown into promising plants in the severe climate of the Northwest. The results of their trial will determine whether we shall import large quantities of the seed, as we have previously done with the Turkestan and Arabian alfalfas, both of which continue in their respective territories to gain in popularity. The Toten clover, secured from Norway, where it is cultivated for its extreme hardiness, is being tested in the Dakotas.

Two of the most interesting and promising introductions of the year were secured through the cooperation of the American minister at Pekin. Forty years ago a French missionary found alfalfa growing in the drier parts of Mongolia. In connection with the life-history studies being conducted by the Bureau, information was secured regarding this plant, the facts indicating that alfalfa was introduced into China about 120 B. C., and that it had been grown in the dry, cold regions of Mongolia ever since. Full information regarding this crop and one or two others was forwarded to our minister, and through his kindness small quantities of seed of alfalfa, a naked oat, and one or two other promising things were forwarded to us. The accounts sent by the missionaries who aided the minister make it seem very probable that the alfalfa is grown under dry-land conditions, and it is hoped the plant will prove a valuable addition to the collection of varieties now being studied in a scientific and practical way at various stations in the West.

New rice varieties.—For the rice growers of the South there have been introduced 46 varieties from different parts of the world, among them the One Hundred Day rices—early sorts, which, in Japan, give crops when ordinary rices fail.

Development of a mango industry.—The fruit growers of our tropical possessions have had their interest in mango growing stimulated by the fruiting of some of our East Indian fine-flavored varieties. All the local nurserymen are ready to sell in quantity several of the introductions of the Department, and not only are the experiment stations of Hawaii and Porto Rico taking up this fruit, but, what is especially important, private plantation owners are planting out orchards of our introduced sorts.

Bamboo introductions.—The growing scarcity of wood for manufacturing purposes has led the Bureau to make some extensive investigations of bamboo culture in Japan and other countries. Already a number of varieties have been introduced and steps have just

been taken for the inauguration of a considerable number of plantations of these important plants in different parts of the South.

Encouraging the production of raw matting material.—Reference has been made in previous reports to the encouragement which is being given to the matting industry of this country. The Department is anxious that we grow the raw material for the manufacture of this important product, of which we import five or six million dollars' worth annually. Our explorers have succeeded in securing an abundance of young stock of Oriental and Egyptian matting plants, kinds which are essential to the success of the industry here. Plantations of these are being established in a number of portions of the South in cooperation with influential men who are in earnest in regard to making this industry a profitable one, if it is practicable to do so.

LIFE-HISTORY STUDIES OF PLANTS.

Closely allied with the extensive work of plant introduction are the studies of the life history of crops and crop plants. This work has nothing to do with the mere testing of varieties. Life-history studies have for their object the securing of knowledge of the requirements and limiting factors of different varieties—knowledge which will tell us why one variety will succeed and why another may fail. The failure properly interpreted may give us an insight into the life history of the variety which will permit of its successful utilization under different conditions.

The date palm.—The plan with the date palm has been applied to a number of our new and promising industries. The date palm was one of the first to be studied in this way and its scientific life history investigated. The results of these investigations, published some four years ago, enabled the Department to predict with reasonable certainty not only those regions where date culture was promising, but the particular varieties most likely to succeed. These predictions have been the means of saving thousands of dollars which otherwise would have been lost through the attempted culture of choice late-ripening dates in localities where they could not possibly have succeeded. During the spring and summer of 1907 a new date garden was established at Indio, Cal. This garden is high enough above sea level to be free from danger of overflow from the Colorado River, whose overflow at one time threatened to overwhelm the cooperative date garden at Mecca, Cal., some 10 miles to the eastward and 100 feet below sea level. A new date garden has also been established at Laredo, Tex., in a part of the Rio Grande Valley where the climate in spring and early summer is the hottest in the United States. It is believed that good dates can be grown in this part of Texas. The date palms in the Mecca garden, now from 2 to 3 years old, have begun to fruit freely, and the famous Deglet Noor and a number of other choice varieties have ripened perfectly, in spite of the fact that the season has been unusually cool. During the past year much interest has been taken in the planting of seedling date orchards in the hope of securing new varieties better adapted to American climatic conditions. Altogether some 150,000 date seeds have been planted in cooperation with growers in California, Arizona, and Texas. These growers will receive one or two offshoots from imported date palms for every 250 date seedlings set out in proper form.

PERUVIAN ALFALFA.—As another feature of the life-history work to which reference has been made, the past season has brought to light a new variety of alfalfa from the high table-lands of the Andes which is even more distinct from the ordinary alfalfa than the promising new sorts introduced from Arabia. Ability to grow at lower temperatures than any other known alfalfa enables this Andean variety, the seed of which was obtained from Peru, to grow throughout the winter in some of our Southwestern States. This form passes without injury through frosts which kill all ordinary alfalfas, while it is almost completely winterkilled in all of the States from the Panhandle of Texas northward. This paradox is explained by the fact that its ability to grow at low temperatures and the autumn frosts which force other alfalfas into a dormant state do not cause this variety to cease growth and harden up its tissues.

HARDY CITRUS FRUITS.—Life-history studies are being applied also to questions concerning the further development of hardy citrus fruits. It has already been pointed out in previous reports how these hardy citrus fruits have been obtained by cross-breeding. In the spring of 1907 a large number of additional hybrids were made with a view to still further improve these types. In studying the life history of oranges a point has been developed which is of great importance in the matter of its hardiness. It is found that most oranges suffer from being forced into growth by warm spells of weather in winter; as soon as they have pushed into a tender growth they are injured by even a very mild degree of cold, which would be without effect on thoroughly dormant plants of the same variety. Studies now being made have for their object the securing of oranges which harden up their wood thoroughly in winter and are not easily forced into new and tender growth.

DROUGHT-RESISTANT OLIVES.—With the opening up of territory in the new Southwest heavy demands are being made upon the Department for information and light regarding the best crops for this extensive dry-land country. Southwestern Texas is a promising field, especially in the matter of arborescent crops. Investigations made in southern Tunis by an expert of the Bureau of Plant Industry have revealed the existence of extensive olive orchards in that region carried on where the annual rainfall is sometimes below 10 inches for several consecutive years and where the annual evaporation is over 100 inches. The olive grown under these extreme dry-land conditions has been imported and shows every promise of doing well in some parts of Texas and Arizona. Steps are being taken to establish experimental orchards of these drought-resistant olives in a number of sections throughout this southwestern region.

WILD FRUITS OF VALUE AS GRAFTING STOCKS.—Studies made the past year in the Southwest have revealed the existence of a number of species closely allied to the almond and peach of the Old World. Several of these occur in very dry situations and one is distinctly of promise as a stock upon which to graft almonds, apricots, and other stone fruits for culture on unirrigated lands. Another species growing in central Texas bears a very early ripening fruit of fair size which is said to be of delicious flavor. Plants of this "wild peach" have been secured and selections will be made with the hope of obtaining a native drought-resistant peach-like fruit which can be grown in regions where peaches do not now succeed.

Cooperation with the Indian Service.—In carrying out these plans of experimental and demonstration work in the southwest, the Bureau of Plant Industry has secured the cooperation of the Indian Service. A testing and demonstration farm has recently been established on the Pima Indian Reservation at Sacaton, Ariz. The Office of Indian Affairs, Department of the Interior, furnishes the land, water, and labor, and the Department of Agriculture plans the experiments and furnishes all the necessary seeds and plants. The Indian Service is well equipped with lands and well-trained superintendents, and their cooperation will make it practicable to carry on demonstrations with numerous dry-land crops, such as alfalfa, dates, figs, olives, etc.

PROGRESS WITH FORAGE CROPS.

In addition to the special work on forage crops connected with foreign introductions and life-history investigations, the Bureau of Plant Industry has a corps of efficient officers and men engaged in investigations having for their object the extension of important forage crops already here, especially alfalfa and grasses. This work also has for its object the improvement of important crops of this nature and the introduction of these improved types or strains wherever they are likely to prove of value.

Extension of culture of alfalfa and other legumes.—The introduction of leguminous crops throughout the different farming sections of the country is considered of the highest importance. The future maintenance of fertility is based on a wise use of such crops. During the year extensive work was carried on, having in view the extension of alfalfa culture into those portions of the country where it is not now a staple crop. About 500 carefully planned experiments were conducted with farmers the past season in cooperation with State experiment stations. In general, cooperators have shown much enthusiasm in these experiments and have spared neither time nor expense to make their work successful. The effect of successful work of this kind in stimulating neighboring farmers to undertake the culture of the crop is especially gratifying.

Encouragement of alfalfa seed production.—The great interest in alfalfa growing throughout the country has created a much larger demand for alfalfa seed than our farmers have been able to supply. This has brought about the heavy importation of foreign seed, some of which has been shipped even to the Pacific coast. With the enormous area devoted to alfalfa in this country we should be exporting seed rather than importing it. Investigations have shown that the yield of seed per acre is partly determined by the cultural methods used and is partly dependent upon varietal characteristics. Both these lines of investigation are being vigorously prosecuted so as to bring about a great increase in the production of American alfalfa seed.

Large yield of Arabian alfalfa.—One of the most promising alfalfas tested during the year is the Arabian type. At Mecca, Cal., this alfalfa has yielded twelve cuttings in the year as against eight cuttings for ordinary alfalfa. At Chico, Cal., seven cuttings of the Arabian were obtained as against five of the ordinary.

Possible identity of Grimm alfalfa with sand lucern.—It has also been observed during the year that the Grimm alfalfa, which is recognized as an important one in Minnesota and other

regions where the winters are severe, is possibly identical with the so-called sand lucern cultivated in Germany and Bohemia. The Bureau has been making special efforts to extend the culture of the Grimm alfalfa throughout the cold regions of the upper Mississippi basin, but has been hampered in this effort by lack of seed. The sand lucern also has been found to be very hardy, and it is proposed to test it fully side by side with the acclimatized Grimm strain.

Improved timothies and other grasses.—A special effort was made during the year to enlarge the scope of the work on improving grasses. The rapidity with which such important grasses as timothy can be improved has already been pointed out. During the year two of the State experiment stations have also taken up this line of investigation. The seed of improved timothies described in previous reports has been distributed for experimental purposes with encouraging results. Work on other important grasses has also been undertaken. Brome-grass, orchard grass, redtop, and meadow fescue have received special attention in this direction.

Encouragement of cowpea culture.—One of the most important forage crops, for the South at least, is the cowpea. During the year extensive investigations have been made of this crop, the principal object being to secure cheaper and better seed so as to bring about a great increase in cowpea culture. Special machinery has now been developed for harvesting the upright-growing varieties. The need is for good varieties producing small, hard seeds that will not crack and that retain their vitality for more than one year. Many new varieties have been secured from foreign countries and a large number of others developed by hybridization, some of which show great promise. The cowpea is to the South what clover is to the North, and the lessening of the cost of the seed and the improvement of varieties are the two important problems that need to be thoroughly pushed.

Extension of sorghum culture.—The various varieties of sorghum have been receiving special attention with a view to their utilization, especially in the South, where the rainfall is more or less deficient. A large amount of seed of improved and pure-bred strains will be available for distribution in 1908. Among the numerous new introductions that are of great promise are two from Natal, one a black-hulled Kafir, having large elongated heads, the other a new type called Pink Kafir, characterized by rather large pink seeds and dense heads. A new sweet sorghum of unknown origin was discovered under cultivation in a single locality in Texas. It is the sweetest variety yet tested and will be disseminated under the name of Honey Sorgo. All these sorghums are proving valuable not only for forage but for grain throughout the Southwest, and their wider introduction is of considerable importance.

Soy beans for rotation on rice lands.—The rice growers of the South, especially in Louisiana and Texas, have long felt the need of a legume that might be grown in rotation on their rice lands. The Department has been successful in introducing a specially adapted variety of soy bean used on the rice lands of central China. These soy beans have been tested and give every promise of filling the need perfectly. Three varieties have been secured, all very similar and characterized by great leafiness, fine stems, and large size, becoming 6 feet high, so that they produce large crops of excellent hay. Thus we have a combination of crops which will, we hope, do for the rice

grower what clover does for the wheat fields of the North, serving not only as a valuable soil improver but an important forage crop as well.

Discovery of an early-maturing vetch.—Other important investigations with forage crops have had to do with the introduction and encouragement of the growing of vetches throughout the South. The vetch is an exceedingly important plant and its much wider use is greatly to be desired. The principal difficulty in securing an extended use of these important plants has been the fact that they can not be harvested in time for cotton planting. The recent discovery of a valuable new vetch which matures as early as the so-called native vetch of the South and which produces very satisfactory crops will, it is believed, obviate this difficulty and result in its extensive employment. Seed will be available for distribution and trial next season.

improving the corn, cotton, tobacco, and other crops.

The special work of the Bureau in the improvement of plants by breeding and selection has been pushed forward during the year with vigor.

Breeding better strains of corn.—Extensive cooperative investigations have been carried on in the matter of corn improvement. Breeding for greater yields, improvement in forage, improvement in sweet corn, and other lines of work have been carried on in cooperation with several experiment stations and with a great many individual farmers throughout the country. Demonstration plots of corn in considerable areas have proved the most successful way of interesting the farmers in this important work. These farmers after a time supply greatly improved seed, thus advancing the work throughout an entire neighborhood.

Method of separating cotton seed.—In the cotton improvement work the introduction of practical methods of seed selection has enabled the cotton growers to get rid of light, inferior seed, and as the result of this work, which has aroused great interest, the yield has been increased from 10 to 15 per cent. The apparatus devised for the purpose of separating the seed has been improved so that it is possible to separate cotton seed into heavy and light seed at a very small cost.

Breeding cottons to escape weevil injury.—Improved and early varieties of cotton are being secured for growing in the boll-weevil districts. Seed of these varieties will be extensively distributed the coming season to the growers for testing purposes. The work of breeding improved varieties of cotton adapted to different conditions in various parts of the South has been continued and further work along this line inaugurated. Extensive selection of the best plants in the cotton fields has been made. Many new hybrids and various crosses have been tested and some promising results obtained. The principles worked out at the Texas Agricultural Experiment Station, in cooperation with this Department, for the purpose of securing cottons of early maturity, were briefly described in my last report. These principles were applied this year by a large number of farmers, with the result of great increases in productiveness for the selected sorts as compared with the unselected. This work has been carried on in the heart of the boll-weevil region, and, we believe, is so far advanced now that it may be discontinued, as the farmers themselves can well continue it. The results, in brief, mean that every farmer

has it within his power to breed productive strains which will so mature their cotton as to give yields exceeding those of old varieties and at the same time in such a way that the injury from the boll weevil will be largely minimized.

Insuring a stand of early planted cotton.—In connection with this work some important investigations have been conducted with the object of insuring a stand of early planted cotton. One of the greatest difficulties in early planting is rotting of the seed or the death of the young plant as a result of unfavorable weather conditions and methods of planting. The ordinary depth of planting ranges from 1 to 2 inches, usually upon a soft seed bed. The result of planting at this depth, and the condition of the seed bed under unfavorable weather conditions, is that the seed rots or the plant is exhausted before it gets through the ground. It has been demonstrated the past year that very shallow planting upon a firm seed bed that is so shallow as to scarcely cover the seed produces plants that make a good strong root, that do not exhaust their energies in getting through the ground, and that are less subject to damping-off and will make a good stand of cotton, even though the weather conditions are extremely unfavorable. The result of this work is believed to be of fully as great importance as the use of early maturing varieties in securing a profitable early crop. The principal shortage in the cotton crop in some localities this year is due more to the failure to get a stand of the early planted cotton than to any other cause. Demonstration work has proved conclusively that good stands could be obtained by shallow planting methods, despite unfavorable weather conditions.

Acclimatization of Egyptian cottons.—Numerous attempts have been made to grow Egyptian cottons in this country. During the year gratifying progress has been made in this work. Egyptian cotton of the Mit Afifi variety having been grown quite successfully under irrigation at Yuma, Ariz. One selection has yielded at the rate of 500 pounds of lint per acre, which is unusually high for Egyptian cotton in this country. Some of the improved Upland strains have also given equal and even superior yields in this region. The Upland varieties that seem at present most promising for this important agricultural section of the Southwest are the Southern Hope, Sunflower, and Columbia, the latter being a variety improved by the Department in South Carolina.

Breeding improved tobaccos.—All tobacco work of the Department was, in accordance with the action of Congress, taken up by the Bureau of Plant Industry the first of last July. One of the most important results of the past season's investigations has been the introduction of the new varieties of tobacco which the Department has originated. The Brewer and the Cooley tobaccos have given increased yields of a better grade of cigar-wrapper tobacco than the unimproved varieties, and in those sections where they have been tested many of the large and successful growers are planning to use these varieties exclusively next season as the result of the favorable experience of the past year. The new and improved types of Sumatra varieties of cigar-wrapper tobacco are being adopted by growers in Florida and the Connecticut Valley for growing under shade. They rank among the best varieties of cigar-wrapper tobacco now grown. Other new varieties are being tested in the various sections

of the tobacco-growing States, some of which have been found to be valuable. A nematode-resistant type of cigar-wrapper tobacco has been produced in Florida. In view of the great annual loss sustained by southern tobacco growers from this injury, the production of a resistant variety is of the greatest importance to the growers. Considerable quantities of seed of the various new varieties of tobacco will be distributed to interested growers this winter for use next season. The demand for such seed in sections where the tobaccos are grown is already beyond the quantities available for distribution. However, sufficient seed has been saved to give to the growers a limited supply, consistent with the introduction of new and improved varieties.

Improvements in handling the tobacco crop.—Improved practical methods of seed selection and seed separation for tobacco have been discovered by experiments and are proving to be of benefit and practical value to all tobacco growers. At the various experimental fields where the tobacco work of the Department is being carried on thousands of farmers have visited the places and have secured from observation the benefit derived from this work. Improved methods of preventing damage from pole burn in the curing sheds have been devised as a result of experiments carried on in different parts of the country the past season. Extensive laboratory work has also been carried on in the matter of the nicotine content of tobacco. The demonstration work in various parts of the regions where the different tobacco types are grown has been continued, with encouraging results.

Work in the improvement and extension of grain crops.

This important line of investigation has been continued in much the same way as touched upon in my previous reports.

Durum wheat.—Efforts to still further extend the durum wheats have continued. The successful production and utilization of this wheat continue, notwithstanding the numerous unfavorable comments and predictions made in reference to it since its introduction seven years ago. Twenty million bushels of last year's crop were exported to Europe. Of the remainder all except a seed reserve went rapidly into domestic consumption, chiefly for bread flour. It is certain, from official figures, that over 6 million bushels were ground in Minneapolis mills. Probably 10 million bushels were used in the country mills of the Northwest. In Minneapolis a large portion of this wheat was blended with Hard Spring, although a considerable amount of straight semolina was made for macaroni factories. In the country mills a considerable quantity of pure durum wheat flour was made.

The 1907 crop of durum wheat in the Northwest is probably about the same as that of last year. It is difficult to follow its extension everywhere. The acreage in the Middle West and Southwest is now, however, becoming important, and the production in those areas this year is probably about 5 million bushels. There is now also a considerable acreage in Montana, Idaho, Oregon, and Washington. Of this new crop over 8 million bushels have been exported to November 1. An important feature of recent shipments is that large amounts are going to northern Europe for bread flour. One-fourth of the entire export is being used in Great Britain. Recently durum wheat

was preferred in Antwerp over No. 2 Red Winter, the latter selling at 2 or 3 cents less per bushel. A dozen or more cars per day are at this time being received in Chicago, all of which is sold to domestic mills.

Statements recently made that durum wheat is deteriorating are found, after investigation, to be incorrect. Samples from certain localities, particularly in the Red River Valley, where it should not be grown, have a large proportion of white, soft grains, but the larger part of the present crop is of good quality.

Extending the winter-grain area.—The Bureau has made a special effort during the year in the continuation of the work of extending the winter-grain area in the Middle West and the North Central States. Grain-growing conditions in these sections have been greatly improved through the introduction by this Department of winter hardy varieties adapted for autumn seeding, the testing and distribution being accomplished in cooperation with the State experiment stations. Tennessee winter barley is now fairly well known throughout Kansas, and is giving from 30 to 50 per cent better yields than spring barley every year. The use of Kharkof wheat has virtually established winter-wheat production over considerable portions of Nebraska, Iowa, and South Dakota.

Introduction of emmer.—Emmer, the grain about which the Department has already published some information, is being more and more recognized as a good stock food and is found well adapted to the dry-land areas. More recently the Department has successfully established a winter hardy variety, which, in addition to the qualities of the ordinary spring-sown emmer, furnishes good fall pasturage.

SOIL BACTERIOLOGY.

The work in soil bacteriology has been extended during the past year to include the whole question of the relation of bacteria found in soils to fertility and crop production. Outside of the work of the Department and two of our experiment stations, very little has been done in this country on this general subject.

Relation of bacteria to fertility.—Though this work has not gone far enough yet to warrant any general statement of results, it has been shown that the failure of nodule bacteria in certain soils is due to the presence in the soils of certain bacteria antagonistic to the nodule form, and that if these antagonistic forms can be removed leguminous crops can be grown and successfully inoculated on these soils. In other cases it has been found that certain soils otherwise in good condition lack effective nitrifying and ammonifying organisms, these soils being improved in fertility when these organisms were supplied.

Distribution of inoculating bacteria.—The distribution of bacteria for inoculating various legumes has been continued during the past year with increasing success. It has been found especially important to carefully examine soil conditions before inoculation, and a method of doing this quickly in the laboratory has been devised, based on the soil-solution work of the Bureau of Soils. Over 18,000 cultures have been distributed during the year, and, from the reports received to date, they have been used with success in the majority of cases.

STUDIES OF WATER CONTAMINATION.

In the water purification work principal attention has been given during the past year to the study of the conditions of water supplies, especially on dairy farms.

Improvement of farm water supplies.—The results of the work showed that the water supplies on a large percentage of dairy farms, especially in the vicinity of Washington, D. C., were in very poor condition, and as the work has extended it has been found that the condition is apparently as bad in other localities. This line of work is especially important, not only to dairy farms but to farms in general, and the Bureau of Plant Industry, cooperating with the Bureau of Animal Industry and the Public Health and Marine-Hospital Service, will do everything possible to improve these conditions.

Work in the Canal Zone.—A great deal has been done also in the treatment of reservoirs for algal pollution. Probably the most striking treatment was that carried out under the direction of the Department experts in the Panama Canal Zone, the work there being highly successful and satisfactory to the canal authorities.

FRUIT INVESTIGATIONS.

Investigations of the marketing, transportation, and storage of fruits have been continued along the lines mentioned in my last report. The grape work and fruit district investigations have also been continued.

Methods of marketing apples.—Particular attention has been given to methods of packing and handling winter apples. Investigation of foreign shipments of these apples indicates that more than 20 per cent of such shipments are classed as "slack," caused by insufficient shaking of the barrels in packing, insufficient filling of the barrels, over-ripeness at harvest, and careless and rough handling.

Improvement in handling and shipping oranges.—Investigations of the causes of decay in oranges from California were continued. Practical demonstrations and trial shipments have shown the results of different methods of packing, handling, and shipping upon the keeping quality of the oranges. This work continues to have the support of all those interested in the citrus fruit industry, and the methods of handling the crop are being changed in many respects. Reliable authorities have estimated that the improvements already effected have resulted in an annual saving to the industry of from one-half million to one million dollars. Preliminary investigations have been begun to determine the causes of losses in Florida oranges, and it has been demonstrated, as in California, that the rough mechanical handling of the fruit is one of the principal causes of the trouble.

Progress in grape investigations.—In connection with the grape investigations, additional resistant varieties have been planted at each of the cooperative vineyards in California, and the work is progressing satisfactorily.

SUGAR-BEET INVESTIGATIONS.

During the year investigations of sugar-beet growing have been continued along lines similar to those discussed in previous reports.

Production of American-grown beet seed.—The development and improvement of American strains of sugar-beet seeds have been con-

tinued. This work is carried on in a number of States and the results have already been very encouraging. Large quantities of American-grown seed have been distributed to farmers, and cooperative experiments were inaugurated whereby it was made practicable to test the seed grown in this country alongside of the best European seed. In all cases the American seed has been found equal to and, in a number of instances, superior to the foreign-grown product.

Results of the year's work.—The special investigations pointed out in previous reports in the matter of breeding beets of high sugar content have been carried on mainly in the State of Washington. The studies on the development of single-germ beet seed have also been continued with encouraging results as to progress. We now have these beets giving progeny of high sugar content and yielding 50 per cent of seed of single germs. During the year a number of diseases of the sugar beet have been investigated and further work has been carried on in the matter of testing fertilizers for the purpose of increasing the tonnage. Some investigations have also been inaugurated in the matter of handling the beets, rotation of crops, and other subjects of a similar nature.

STUDIES OF POISONOUS PLANT

Investigations of plants poisonous to stock have been continued during the year with encouraging results. The causes of a number of serious outbreaks of stock poisoning have been investigated and remedies prescribed. Some important results have been obtained during the year in the matter of loco poisoning, its cause and remedies.

Cooperation with the Forest Service.—In connection with the work of the Forest Service important questions have arisen regarding injury to stock through the eating of poisonous plants. The Bureau of Plant Industry has entered into cooperation with the Forest Service, whereby examinations of this nature will be made with a view to taking steps for the prevention of losses in the future.

THE GROWING OF DRUG CROPS AS A NEW INDUSTRY.

It has been pointed out in previous reports that from 10 to 15 million dollars are sent abroad each year for the purchase of drug crops, many of which could be grown here. With a view to determining the conditions of soil and climate where these drug crops will grow to the best advantage, experimental work has been under way for some time.

Establishment of the camphor industry.—Drug gardens are now established at a number of points, and as a result of this work it is believed that the camphor industry has been established on a firm basis. A large acreage is being planted to camphor in Florida, and interest in the growing of this crop is shown elsewhere. From 3,000 to 4,000 acres of the trees are being prepared for planting in Florida alone.

PROGRESS IN SEED STUDIES.

The Department is making a special effort to educate the farmer in the matter of good seeds. With this end in view many thousands of tests have been made during the year, both for seedsmen and for farmers.

Decrease in practice of seed adulteration.—The work on seed adulteration has been continued with gratifying results. Aside from the continued sale of Canada bluegrass seed for Kentucky bluegrass seed, fewer cases of adulteration have been found than in former years. The importation of low-grade red-clover seed has continued, some lots containing over 8,000,000 weed seeds per bushel.

Investigation of dodder injury.—During the year special attention has been given to the loss caused by dodder infesting clover and alfalfa. Dodder has proved such a serious pest the past year throughout the world that the International Seed Control Congress at Hamburg, in September, 1906, took action toward encouraging all governments represented to adopt measures for the extermination of this pest.

CONGRESSIONAL SEED DISTRIBUTION.

The work of securing, packeting, assembling, and mailing the seed for Congressional purposes was carried on the same as in past years. This work is now so systematized that it goes along smoothly, despite the large quantities of seed that must be secured and sent out. The total number of packages put up and distributed has remained the same for the past six years. In the annual distribution 6,400,000 packages of miscellaneous vegetable seed are put up and sent out, each package containing 5 packets, and 800,000 packages of flower seed are put up and distributed in the same way, each package containing 5 packets.

EXPERIMENTAL GARDENS AND GROUNDS AND ARLINGTON FARM.

The Department grounds have been further improved during the year by the addition of a large number of new shrubs and trees and by repairs to the greenhouses and fences. A new greenhouse has been constructed during the year, which is a model of its kind. Over 90,000 plants of many varieties were propagated and distributed, and the important hybridization work which the Bureau is carrying on was continued with satisfactory results.

Work of the Arlington Farm.—Many problems of a general nature connected with crop growth and crop conditions are being worked out at the Arlington Experimental Farm. The Forest Service, the Bureau of Entomology, and the Bureau of Soils have each been allotted certain areas for working out problems pertaining to their respective investigations. The greater portion of the farm, however, is used for the various lines of work conducted by the Bureau of Plant Industry. The drug garden has been successfully established, the peach orchard has now begun to bear, a small cranberry bog has been established, and extensive tests with beets and radishes have been conducted at the testing gardens. The condition of the soil on the farm has been greatly improved during the year. Two additional greenhouses have been constructed and other improvements have been made.

HELPING THE FARMERS IN THE BOLL-WEEVIL REGION.

The Bureau of Plant Industry has been engaged for the last three or four years in encouraging the diversification of crops, the improvement of systems of farm management, and the handling of farms in the sections invaded by the boll weevil and those in which it would seem that the boll weevil is likely soon to appear. This general

propaganda work has been under the supervision of a representative of the Department, with headquarters at Lake Charles, La., and has met with great and continued success. The object of the work is simply to bring to the attention of the farmer plain and practical methods of bettering his condition, improving his soil, and growing larger crops. Diversification is taught as far as it can be taught under existing circumstances. The people are reached largely by personal contact with representatives of the Department. Close touch is kept with all those who are working in order to determine definitely the difference in actual money returns from farms or portions of farms handled by the old methods and on the newer plans. During the past year the Department cooperated in this way directly and indirectly with more than 100,000 farmers in the more important cotton States.

GRAIN STANDARDIZATION.

Attention was called in my last report to the unsatisfactory methods of handling and grading grain now in vogue. The laboratories established at Baltimore and New Orleans have continued to receive the cordial cooperation of all interested in the handling of grain and have determined some of the more important factors entering into the question of standardizing present methods and grades.

Development of moisture-testing apparatus.—The moisture-testing apparatus introduced last year by the Department has been used with great success in these laboratories. This apparatus has been adopted by many commercial organizations, and they report that it has been of the greatest value to them in determining the moisture content of grain. This apparatus enables us to determine the moisture quickly and accurately, making it entirely practicable for use under commercial conditions.

Establishment of new laboratories.—Additional laboratories have been established at Duluth, Minneapolis, St. Louis, and New York. At Duluth and Minneapolis special attention is to be given to finding the best method of accurately determining and measuring dockage. Through the work of these laboratories and the general investigation of grain-trade conditions the Department is coming into possession of much valuable information which should enable it to be of great assistance in straightening out the unsatisfactory conditions now existing.

Need of uniformity in inspecting and grading grain.—It becomes more and more evident as this work progresses that some uniform system of inspecting and grading grain is absolutely imperative. Our producers of grain suffer through the lack of uniformity in grading, and our markets abroad are injured by lack of confidence in the grades established. It is believed that the end to be attained is through National inspection of all grain entering into interstate and foreign commerce, and the attention of Congress is respectfully called to this important question.

FARM MANAGEMENT.

Farm management investigations have been continued during the year along the lines set forth in previous reports. For the purpose of systematizing the work the country is divided into sections and the systems of successful farm management in these sections is being studied by experienced men.

Cropping systems for stock farms.—From data which have been thus secured the Bureau has been enabled to outline and plan cropping systems to meet the needs of those desiring specific information along these lines. During the year a simple method of planning cropping systems for stock farms has been developed and such systems have been worked out and applied to a number of farms in various parts of the country.

Encouragement of diversification of crops.—In many sections of the country it is found that systems of farming have been developed based on a single crop. Frequently this crop is grown year after year on the same land and forms the sole basis of the farmer's income. Such systems are found in some of the wheat-growing areas of the Plains region and the Far West. In these sections the land is becoming infested with many bad weeds. In some parts of the corn belt corn has been grown continuously for sale until the land has become depleted and insect pests are gradually reducing the yield of corn. In the Southern States the continuous clean cultivation of cotton has destroyed the humus of the soil and yields are unsatisfactory. In all these instances the Department of Agriculture is working out systems of diversified farming which provide for the maintenance of fertility and render the farmer less dependent on the single source of income.

Studies of methods on successful farms.—Realizing that preeminently successful farms have solved many of the most important problems confronting farmers in this country, experts in farm management in this Department have continued the study of such farms with valuable results. The success which a few men have attained in farming has in no case been due simply to good judgment in buying and selling. In every case thus far studied success has been due not only to good business methods, but to the application of the teachings of science in crop production and in the care and management of stock. Farmers of this class are invariably well informed concerning scientific investigations relating to farming. During the year careful studies of several successful farms have been completed and the results have either been published by this Department or are now in course of preparation for publication.

Value of the prickly pear as stock feed.—As a special investigation the Office of Farm Management has made a study of the prickly pear as a farm crop during the year. Conservative estimates based upon actual feeding tests and upon yields obtained from cultivated fields show that 1 acre of cultivated pear will furnish roughage for one cow the year round. An average production of nearly 23 tons of green feed per acre per annum has been grown upon the experimental grounds near San Antonio, Tex., during the past three years. The native growth has been used as stock feed for many years, but its cultivation was never attempted until three years ago. The response to cultivation has been remarkable, eight times as much forage being produced upon cultivated ground as upon uncultivated ground. When it is considered that the crop economizes labor, that a plantation is good indefinitely when once established, that it can be fed in a succulent condition every day of the year, that it is relished by nearly all farm stock, and that it is extremely resistant to drought, it is clear that this crop must become an important adjunct to the live-stock industry of the Southwest.

FOREST SERVICE.

RETURNS FROM THE NATIONAL FORESTS.

At the beginning of the fiscal year the area of the National Forests was less than 107,000,000 acres; at its close, more than 150,000,000 acres. Nearly all the timber land of the unappropriated public domain is now under actual administration by the Forest Service. This means that it is being protected against fire, theft, and wasteful exploitation, that its power to grow wood and store water is being safeguarded for all time, and that nevertheless its present supply of useful material is open to immediate use wherever it is wanted. The timber in the National Forests, which is the legacy of the growth of centuries, is now in the truest sense public property, administered for the benefit of the people—primarily for the benefit of the people of the West, since they are nearest at hand, but on the whole for the benefit of every part of the country, since the welfare of every section is interwoven with that of all others. The communities and settlers adjacent to these forests are safe from any fear of monopoly of one of the chief necessities of civilized man.

The Government is not a landlord owner, but a trustee. As a trustee it must treat all alike and refuse permission to the first comer to pocket the share of all the rest. Hence timber is given away through free-use permits only in small quantities to the actual home maker, who comes to develop the country, and in larger quantities to communities for public purposes. Otherwise it is sold to the highest bidder, but under such restrictions as look to the maintenance of a lasting supply answering to the needs of the locality, to be had without favoritism and without extortionate demand based upon the necessity of the consumer.

Though the value of the forests as public property is not measured by what they turn into the Treasury of the Government, but by what they contribute to the welfare of the people in the States in which they lie, it is none the less a matter of striking importance that the receipts from them during the year totaled over $1,530,000, or almost exactly twice those of the previous year, and more than twenty times those of two years ago. The cost of their administration to the Government, including that part of the expenditures of the Forest Service in Washington properly chargeable under this head, were less than $1,500,000. In other words, the forests are already self-supporting, though they have been under the control of expert foresters less than three years. The total expenditures of the Forest Service for all purposes during the year was $1,825,319.50—considerably less than I estimate that the receipts from the Forests will be during the present year. As yet, however, from the standpoint of true economy the expenditure for the protection and improvement of these Forests is far too low. France spends annually upon state forests less than one-fiftieth the area of our own over $2,500,000 and realizes $4,230,000; Prussia spends upon 7,000,000 acres over $11,000,000 and realizes $17,054,144; Saxony spends upon only 400,000 acres over $900,000 and realizes $1,651,882. Yet in all these countries, unlike our own, the forests have had great sums spent upon them in the past in the form of permanent improvements, to which are largely due their present returns. A forest can no

more be made to yield a constant return in valuable products without the investment of capital in improving the property than can a farm. If the United States spent as much per acre upon these forests as Prussia does upon hers, they would cost each year $250,000,000. If they brought in as much per acre, the gross revenue which they would yield would amount to $650,000,000, and the net revenue to $400,000,000. The development of the wealth-producing possibilities of the National Forests—not, it must be insisted, in the narrow sense of income yield to the National Treasury, but in that of economic usefulness to the people—is hardly begun.

I have asked for an appropriation for the Forest Service during the fiscal year 1909 of $3,200,000. This, if all spent upon the National Forests, would amount to 2 cents per acre. France spends annually upon her state forests 95 cents per acre, Switzerland $1.32, Prussia $1.58, and Saxony $2.32. These are the countries in which the management of the forests is most profitable in products. The countries which spend most do so because their forests are brought to a high state of development. Thus utilizing their full productive powers, they derive from them a net profit which is very high. On the other hand, the countries like Sweden, Hungary, and India, which spend from 2 to 34 cents per acre, derive a very low revenue—in other words, a small volume of products—from their forests.

NATIONAL FORESTS NOT EXPERIMENTS.

It is worth remembering in this connection that these Forests have not been set aside, and the proposed expenditures are not to be made, in order to try a doubtful experiment. It is true that the practice of forestry has only lately begun to be applied to American conditions, but this is far from meaning that it is something new, untested, or of uncertain issue. It is as sure that forest land can be made to grow successive crops of trees under proper methods as that plow land can be made to grow successive crops of wheat; as sure that forests can be made to conserve the water supply as it is that manuring enriches the soil. As time passes, it will doubtless appear that the principles which centuries of experience in older countries have placed at our command can be applied with increasingly good results as we grow more familiar with our own special conditions; it may be that mistakes will be made in individual cases; but of broad success there can be no question. The issue is sharply between caring for our forests by applying a system of known efficiency, or suffering certain loss not only of the forests, but of usable water and soil as well, through the operation of causes as certain to act as are the rivers to run to the sea.

THE GAIN IN THE USE OF THE FORESTS.

The use of the National Forests by the people of the West is increasing at an extraordinary rate. The value of timber sales, the number of stock grazed, the demand for free-use and special-use permits all tell the same story. The Forests are more and more contributing to the material welfare of those in their vicinity. This is altogether as it should be. But it is out of the question to transact twice as much business and protect a much larger area of Forests without a corresponding increase in the administrative and protective force. The demands imposed by the enlarging use of the Forests diminished to a very dangerous degree the attention that could be given

to the work of patrol. The force upon National Forests must be increased as the business of these Forests increases.

SOME IMMEDIATE PROBLEMS.

Through records of the effects of all cuttings made, knowledge is being gathered which will make it possible constantly to improve upon the methods employed in harvesting the timber crop and replacing it by another. Two other problems under investigation which are of special importance are range improvement and forest extension.

Unlike the demand for timber, the demand for range in the National Forests is already large enough to employ practically the full productive capacity of the land. There were grazed last year on the Forests over 1,200,000 horses and cattle and 6,650,000 sheep and goats, representing a total investment of perhaps $44,000,000 and a probable annual profit, under the conditions of recent years, of $8,000,000. Upon the cattle industry of the western range depends to a large extent the farmer of the prairie States for the profitable marketing of his corn crop, the workingman of the East for his food supply, and our foreign trade for one of its important articles of export. The entire country, with its rapidly growing population, is therefore concerned in the power of the range to supply summer feed to the stockman. Under the conditions which obtained before the Forest Service undertook to regulate grazing, the carrying power of the range had seriously fallen off through overgrazing and competition. By putting a stop to these evils the Forest Service has not only partially restored the range to its former carrying power, but has also given greater stability to the stockman's industry by recognizing his right to protection against newcomers, and made it possible for him to bring his stock through in better weight and condition. Nor is this all. An exhaustive study of the possibility of range improvement through artificial seeding, through changes in the present methods of handling stock to favor the growth of the best native forage plants, and through extermination of poisonous plants has been inaugurated. The whole problem of range control and improvement will be pursued until every part of the range in National Forests is producing the best crops of forage which the circumstances will allow.

Forest extension opens a field the importance of which can hardly be overestimated. The fires of past years and centuries have stripped great areas of western mountain timber land of all forest growth. The need of conserving the rainfall and snowfall of these areas makes reforesting a step of urgent necessity. At the same time it is often one of the utmost difficulty. In dry climates particularly (where the need is greatest), to establish a forest without prohibitive expense calls for the most careful study of methods and of the adaptability of different species to the conditions. Even after plantations are apparently well established a season of unusual drought may turn the scale against the growing trees. Millions of acres must be planted—and this means that thousands of millions of small trees must be raised—but there is yet much to be done before planting on a scale commensurate with the needs can be begun. This preliminary work is being pushed with as much energy as the funds available for the work will permit.

In a large part of the Northwest, at least, there is good reason to believe that broadcast sowing of seed may be practicable. If this

proves to be the case, the way will be open for restoring to forest cheaply very much of the burned-over land. Hitherto the experimental sowings have shown surprisingly good results. The country's need of timber is certain to be so acute before many years that the work can not be entered upon too quickly. Broadcast sowing, however, to give good results, must probably be confined to heavy seed years, when a food supply for the animal life of the forests is abundant enough to prevent too great interference with the sowings.

NEED OF A CENSUS OF STANDING TIMBER.

That the United States is even now nearing a time of severe scarcity of lumber is no longer a matter of doubt. Each year makes a further heavy inroad upon the remnant of our virgin forests, and the growth of our abused and depleted forest lands for three years would not meet our needs for one. Under these grave conditions it becomes a matter of very practical and exigent importance to know with some degree of accuracy how much standing timber we have. Many commercial organizations have, during the last few months, passed resolutions asking the Government to undertake a census of our sources of supply. The Bureau of the Census and the Forest Service are ready to act together to take such a census, if this is made possible by action of Congress, and I urge most strongly that the appropriation necessary for this purpose be made. Until it is known not only how fast our forests are being used, but also how much is in reserve and how fast new wood is growing, our measures to meet the crisis will be planned in ignorance of some of the essential facts.

WORK OF THE YEAR.

ADMINISTRATION.

The business efficiency of the Forest Service organization was put to an extraordinary test by the work of the year. Great credit is due the members of its administrative force for the energy, patience, and good sense with which they assumed greatly increased responsibilities and discharged trying duties. The increased volume of National Forest business imposed a severe strain upon the machinery of organization and the personnel. Special mention should be made of the work of the forest rangers, the rank and file, who form, so to speak, the firing line of the Service. Their pay is low—too low for the requirements placed upon them—their responsibility great, and their life one which makes necessary self-reliance, initiative, and good judgment. The conspicuous success which the Forest Service has achieved in making the Forests useful to the people of the West is due in no small measure to the fidelity of these true public servants, performed as a part of the day's work and without thought of other reward than their own consciousness of duty well discharged. I am glad to acknowledge the indebtedness of the Department to these men.

IMPROVEMENT WORK ON NATIONAL FORESTS.

The special fund of $500,000 appropriated by Congress for permanent improvements on the National Forests is being well spent. Before this fund was made available the Forest Service was compelled to draw upon the sums at its disposal for the payment of current expenses, to provide whatever was spent in betterment of the Forests.

Such expenditures were virtually reinvestments of a part of the income yielded by the Forests. Rangers' quarters, fences, fire lines, bridges, roads, trails, and telephone lines facilitate the transaction of business, the use of the Forests, the convenience of the public, and the protection and development of the property. The Forests were not created to be kept as wildernesses. They must be opened both to use and to habitation. In time they will increasingly be places for homes, industries, villages, and towns. The more they are made traversable and habitable the greater will be the development of their wealth-producing power. This work of development is as yet hardly well begun, for the size and capital value of the forests open a field of vast possibilities. That improvements do actually bring increased use the results of those already made leave no doubt. Provision should be immediately made for carrying on this work.

GRAZING.

Two years of trial have amply demonstrated the wisdom of the present method of range control. Since it is an essential part of that method that where the grazing privilege is sought for more stock than can be safely admitted some must be shut out, there is necessarily a certain amount of dissatisfaction among those to whom permits for a part or all of their stock are refused. Such dissatisfaction can not be allowed to weigh against what is manifestly the best interest of the community and the grazing industry itself. The only alternative, other than the old and ruinous one of permitting the range to be scrambled for by all alike, would be to grant the privilege to those willing to pay most for it. This would be a grave mistake. It is not in the public interest that the small owner who has established a home near the Forest should be crowded out by the big man, nor that those who have identified themselves with a locality should have to give way before the transient herd. The Forests serve their best purpose by promoting settlement and development. The evils of former conditions, with their rivalries, their injustices, and their wastefulness through overcrowding, are fresh in the minds of all. The purely selfish outcry of those who think themselves strong enough to look out for their own interests, and therefore object to a system which begins by asking who has the best right, is to be expected and must be disregarded.

That the system works well for the stock is attested by the excellent weight and condition which has been attained on the Forest range. No longer hustled from one place to another in hasty competition for feed, they are now brought to the end of the summer in better flesh and with fewer losses than formerly. In short, regulation of the grazing is proving beneficial to the range, to the owner of stock, and to the community. It is turning forage into money to better advantage than could be secured under any other system. Through the recognition given to associations of stockmen those who use the range have a voice in its management, while control by the Government prevents favoritism and insures even-handed justice to all.

The number of stock-grazing permits issued during the year approached 24,000, as against less than 17,000 the previous year, and the receipts were over $850,000, as against $515,000. This increase was mainly the result of additions to the number and area of Forests

under administration, but to some extent also the result of improved range condition brought about by grazing control. No charge was made for grazing upon Forests proclaimed after March 1. Another year will beyond a doubt show further increase. The growing volume of business is another illustration of the greater use of the Forests. To handle it has severely taxed the present field force. The greater the number of stock on the Forests the heavier are the demands laid upon the rangers, one of whose duties it is to enforce the grazing regulations. A substantial increase in the administrative force of the Forests will be needed to handle the grazing business of another season.

Of 183 cases of grazing trespass, 165 were settled by the payment of damages. Action for criminal trespass was brought against five trespassers. The constitutionality of punishment for criminal trespass still awaits final determination through decision by the Supreme Court of the United States, but two additional decisions of inferior courts have during the year affirmed the criminal liability of violators of the regulations prescribed by the Secretary of Agriculture. The civil liability of trespassers has never been questioned.

SILVICULTURE.

The practice of forestry begins with the cutting of timber; the principal tools used in cultivating a forest are the saw and ax. Preparation of the ground for a future crop is accomplished by felling the mature growth, and control of the character of the future forest is through decision as to what trees shall be removed and what left standing, unless renewal is to be brought about solely through planting. It is, then, through timber sales that forest management is being introduced upon the National Forests.

Receipts from the sale of timber from the Forests increased threefold over those of the year before, and brought in $600,000. But a better gauge of the rate at which the demand of the public for timber is increasing is the contracts made by purchasers. When large bodies of mature timber are so situated that they can be utilized only by a purchaser who can undertake operations on a large scale, sales are made under contracts permitting the work to be continued through several successive years, a specified amount being cut each year. No contracts are made for a longer period than five years. In other words, sufficient time is given to enable a large operation to be carried through, but speculative purchases are not allowed. The sales contracted for during the year totaled 950,000,000 board feet of lumber, besides cordwood and other material, with an aggregate value for all classes of material of over $2,500,000, as against $500,000 sold the previous year.

It is evident that if the demand for timber continues no greater and prices go no higher than at present the Government will in five years be taking in from timber sales at least $2,500,000 annually, since payments will then be coming in on contracts entered into each intervening year. But the demand is certain to increase up to the full amount which the Forests can supply. Eventually it will be necessary to impose a limit to the cut, which must never exceed the rate of growth. Anything beyond this is overcutting. The farmer who fails to make one grain crop last over until the next one matures can usually buy from others, but for many communities dependent on National Forests for their supplies of wood no outside sources of sup-

ply are likely to be available. Data are now being gathered from which to compute the present stand and the rate of growth on the different forests, in order that excessive cutting may be prevented.

To become productive, however, a forest must begin to be cut over. No wood is making in a mature forest. Such a forest is simply a storehouse of wood. But after young growth gets under way the forest becomes a manufactory of wood. So far as is consistent with a proper regard for the needs of the future, all mature timber on National Forests is available for use. Waste in utilization of timber cut is not permitted; slash is piled and, if necessary, burned to lessen the fire risk; unnecessary destruction of young growth is prevented; and measures are taken to insure reproduction from self-sown seed.

The work of marking and scaling timber, enforcing contract stipulations, and other matters incidental to the sales, combined with the demands made by the free-use applications, called for the most strenuous efforts on the part of the administrative force, and often compelled the neglect of other duties.

In addition to the work on the National Forests, forest studies were carried on in cooperation with the States of California, Delaware, Kentucky, and Missouri, and assistance was given to private owners of woodland concerning the management of their tracts.

FOREST PRODUCTS.

Hand in hand with the work which seeks to enlarge our future supplies of timber goes that which seeks to secure the best and most economical use of what we have. Important results have marked the work of the year in this line. The studies of the Forest Service in the field of wood preservation have now reached a point at which it may be predicted with some confidence that the treatment of timber for use under conditions which expose it to rapid decay will soon become widespread. This will mean a marked reduction in the drain upon our forests.

An easy and inexpensive method of treating fence posts has been perfected which makes it possible for any farmer to make the quickly decaying woods, still abundant because hitherto thought almost worthless, far more durable than untreated white oak or chestnut. Demonstrations of this method before southern farmers were received with enthusiasm. For the Middle West, where the common woods are seldom resistant to decay, the matter is certainly no less important. Essentially the same method is being applied to the butts of telegraph poles and to mine props. The enormous consumption of timber for the latter purpose and the extreme rapidity with which it decays in the dampness and darkness of the mine open the prospect of a large economy from the use of this method of treatment, which has stood a searching practical test in Pennsylvania coal mines. By applying the same treatment to timbers from the National Forests a use will be found for dead wood and a decided benefit will be conferred on the users of the timber. The work includes a study of the comparative merits of different kinds of preserving fluids.

The investigations aimed at discovering new sources of paper pulp have demonstrated that a number of woods of abundant supply, never in the past thought of for the manufacture of paper, are capable of yielding pulp of standard grade. Studies in wood distillation are establishing the practicability of obtaining turpentine from waste southern pine material.

Ten thousand separate tests of the strength of timber, largely in the form of full-sized structural beams, have established the relative value of a number of woods and proved the fitness for hitherto unthought of uses of several of them.

Studies of wood production and consumption have added materially to our knowledge of the rate at which we are drawing upon our reserves of standing timber.

BUFFALO IN WICHITA NATIONAL FOREST.

On March 25, 1907, the New York Zoological Society arranged with this Department to establish a herd of American bison on the Wichita National Forest in order to provide for the perpetuation of the species. The Zoological Society offered to send 18 buffalo of pure breed from the New York Zoological Park to the Forest. An appropriation of $15,000 was made by Congress for the purpose of fencing a buffalo pasture and providing the necessary buildings. This work will be completed early in the ensuing fiscal year. An area of about 8,000 acres is inclosed, and the herd placed under the care of a forest officer experienced in the handling of buffalo.

BUREAU OF CHEMISTRY.

INCEPTION OF THE WORK FOR THE ENFORCEMENT OF THE FOOD AND DRUGS ACT.

During this fiscal year an unusual development in the work of the Bureau of Chemistry has taken place, due to the enactment of the food and drugs act of June 30, 1906, which became effective on the first day of January, 1907.

ESTABLISHMENT OF REGULATIONS.

Previous to this date it was necessary to carry out the provisions of the law for the establishment of regulations. To this end a committee consisting of H. W. Wiley, Chief of the Bureau of Chemistry; S. N. D. North, Director of the Census Bureau of the Department of Commerce and Labor, and James L. Gerry, Chief of the Division of Customs of the Treasury Department, acting for the Secretaries of Agriculture, of Commerce and Labor, and of the Treasury, respectively, prepared a set of tentative regulations. Great care was exercised in the preparation of these regulations, not only that the provisions of the law should be executed fully, but also that there should be no unnecessary annoyance or burden placed upon the trade. The regulations were finally completed, signed, and promulgated on October 17, 1906, as Circular 21 of the Secretary's office.

Between January 1 and June 30, 1907, the personnel of the Bureau was more than doubled, the increase being divided among the clerical force, the chemical assistants, and the corps of inspectors. While work incident to the enforcement of the interstate feature of the law was in process of organization, a much more rigid execution of the law relating to imported foods was established. This was possible because under the previous laws the machinery for the inspection and analysis of imported foods had been already well organized.

SUPPORT ACCORDED THE NEW LAW.

Although up to the 1st of July no actual cases had been instituted in the courts under the food and drugs act, the moral effect of it was

apparent in every branch of trade connected with the food industry. One of the most gratifying features of this preliminary activity has been the almost unanimous support accorded by the trade to the principles of the law. In most instances manufacturers of food products, as well as dealers therein, have expressed their cordial support of the act and offered their hearty cooperation in securing its execution. The importance of this fact can not be overestimated, since the difficulty of enforcement, if the entire trade were opposed, would be practically insuperable. Supported, however, not only by public opinion, but also by the active collaboration of producer and consumer, the food law will have that moral support which is absolutely necessary to secure more wholesome and properly branded food and drug products for the market.

APPOINTMENT OF FOOD AND DRUG INSPECTORS.

A civil-service examination was held to secure inspectors for the enforcement of the food and drugs act, appointments were made, and on June 3 these inspectors reported at Washington for instructions as to the policy to be pursued in the enforcement of the food and drugs act and the practical details of inspection and sampling. By June 30, 1907, the inspectors had been assigned their respective territories and had taken up temporary headquarters there. In making these assignments two objects were kept in view, namely, the location of branch food and drug inspection laboratories and the strategic positions offered by channels of interstate commerce.

ORGANIZATION OF FOOD AND DRUG INSPECTION WORK.

The board of food and drug inspection was created by the Secretary of Agriculture on April 25, 1907. The duties of the board are to consider all questions arising in the enforcement of the food and drugs act of June 30, 1906. The Bureau of Chemistry is charged under the act to perform whatever analytical work may be required for the information of the board. The board reports directly to the Secretary. Its personnel is as follows: H. W. Wiley, Chemist and Chief of Bureau, chairman; F. L. Dunlap, Associate Chemist; and G. P. McCabe, Solicitor of the Department.

Food and drug inspection laboratories are now established, or are being installed, at New York, Boston, Philadelphia, Chicago, New Orleans, San Francisco, St. Paul, Detroit, Savannah, Seattle, Buffalo, Kansas City, Denver, Galveston, Portland (Oreg.), and Cincinnati. Others will be established as the work requires.

These laboratories examine the imported samples taken at the port of entry and the interstate samples sent in by the inspectors, referring violations of the law and doubtful cases to the Washington office for action, and releasing those found to be according to law.

FOOD RESEARCH WORK.

In nearly all of the laboratories of the Bureau of Chemistry important research work bearing on practical problems in the analysis of foods, drugs, or cattle foods is in progress, the elaboration of new methods and the improvement of those in use being of the greatest importance in the examination of products under the law. Investigations illustrative of such researches are as follows: Work on the composition and adulteration of flavoring extracts and methods for their analysis; the effect of cold storage on fowl, game, milk, and

eggs, in which work the bacteriological chemists play an important part; the study of canning products, such as canned corn, tomatoes, peas, catsups, etc., with special reference to the use of preservatives, including both factory inspection and laboratory experiments; methods for detection of the artificial coating of rice; a study of American honeys, involving the chemical analysis of 112 samples and the microscopical examination of the pollens found therein; an investigation of the ice cream and milk supply of Washington, D. C., in the course of which about 800 samples were examined from both a chemical and bacteriological point of view; and an analytical and microscopical examination of American cattle foods as found on the market, including 365 samples.

The question of the use of sulphur in bleaching food products has been given special attention and valuable data have been obtained, both as to the accuracy of the analytical methods employed for the detection of free and combined sulphurous acid and as to the extent of the use of this bleaching agent.

The other phase of this question, namely, the effect of sulphurous acid and sulphites as determined by physiological experiment upon 12 young men at the hygienic table conducted by this Bureau, was solved by the compilation and comparison of the data so obtained, which show unmistakably the injurious effects of this preservative, especially in reducing the number of red corpuscles in the blood.

The researches in the drug laboratory included, among others, the examination of samples furnished by the Post-Office Department of drugs sent through the mails, samples of drugs submitted by the Council of Pharmacy and Chemistry of the American Medical Association, the examination of hops and of glycerin to determine whether they were contaminated with arsenic, and of miscellaneous drug products, such as headache powders and so-called "kidney cures." Much important work on methods has been done, including a special study of methods for the detection of enzyms in medicinal agents, especially for the purpose of ascertaining to what extent these bodies render various substances available to the human system.

MISCELLANEOUS INVESTIGATIONS.

Among other important studies conducted in the Bureau of Chemistry, having a direct and practical bearing on the agricultural interests of the country, are the following: Examination of insecticides and fungicides; study of the effects of trade wastes, particularly smelter waste, on vegetable and animal life; investigations looking to the utilization of the native wild sumac as a source of tannin; studies for the development of the wood turpentine industry, and cooperative experiments on the effect of varying climatic conditions on wheats, particularly on newly introduced varieties, and on the sugar content of Indian sweet corn.

CONTRACT WORK.

The value of the examinations made of Government supplies furnished on contract is shown by the fact that the number of samples analyzed in this laboratory was almost doubled during the past year. The examinations on which the purchase of practically the entire supplies of the Bureau of Engraving and Printing was based alone

aggregated nearly 400 samples. The varied character of the samples received makes necessary considerable research work for the development of suitable methods. Both a monetary advantage and an improvement in the character of the supplies is insured by the surveillance of this laboratory.

BUREAU OF SOILS.

There are in the continental United States 1,900,947,200 acres of land. Of this, the Twelfth Census showed 838,591,774 acres in farms, with 414,498,487 acres in improved lands and 289,734,591 acres actually in crops.

With a more thorough knowledge of the soil and its adaptation to crops and the proper methods of soil management, the full extent of the agricultural development which may take place in the United States in the future is very great. The undeveloped portions of the United States are not confined wholly to the arid West, portions of which are now rapidly filling up, although this constitutes the greater part. When we realize that we have 77,000,000 acres of swamp land in the eastern half of the United States—an area equal to all of the New England States, New York, and half of Pennsylvania, or to the combined areas of Illinois and Iowa—which can be reclaimed, and which, under the prevailing climatic conditions when so reclaimed, are exceedingly productive, and when we realize that only 16 per cent of the State of Louisiana, for example, and a smaller percentage of the State of Texas is in improved lands, the possibilities of development become more apparent.

The soil-survey work of the Bureau is the largest undertaking of the kind that has ever been inaugurated in any country. The area surveyed and mapped during the past fiscal year was 20,560 square miles, or 13,158,400 acres, and there have been completed to June 30, 1907, surveys covering a total of 139,247 square miles, or 89,118,080 acres. This area is more than 15 per cent of the amount represented by the farm lands of the United States as given in the preceding page. The work has been so distributed as to include every large representative district in the United States, and has given a knowledge of the soil resources of the country far beyond what was ever conceived of before.

THE PROBLEM OF SOIL FERTILITY.

The Bureau, not content with merely showing the character of the soils and reporting upon their adaptation to crops, has, under the wise provisions of Congressional enactment, been very active in actual demonstrations of the possibilities of further development of these lands in the extension and introduction of new crops and developing new agricultural industries. In addition to this the Bureau has made a special study of some of these soils and of the soil conditions controlling fertility and crop production; and these investigations have given a new view point of the whole subject of soil science, which has aroused a new interest in soil investigations.

One of the most important problems now confronting the agricultural public is the intelligent use of commercial fertilizers. In some sections of our country, especially in the South and East, the quantities now used are enormous, and this use is gradually extending. That the amount of money annually invested in fertilizers by the

farmers of the country, now amounting to upward of $100,000,000, will continue to increase seems certain. But just as certainly a large percentage of the money—perhaps a third—is annually wasted and brings no adequate return, owing to a lack of understanding of the soil's requirements.

This problem has been engaging the attention of the Bureau of Soils for a number of years, and it has been found that this wastage of the farmer's capital is due in large measure to incorrect ideas which have long prevailed regarding the manner in which the soils feed our crops and the influence of fertilizers upon this feeding. As might be expected from their origin, soils contain numerous fragments of the common rock-forming minerals. These fragments are accompanied more or less by alteration and decomposition products.

The widely diffused minerals of the soil are all slightly soluble in the soil water, and it has been shown that this solution is the natural source of food supply for the plants. As the dissolved plant nutrients are removed, either by the growing plants or by other natural agencies, the minerals continue to dissolve and thus replenish the solution. As these minerals are so widely distributed in various soils, the mineral composition of the plant-food solution is not very different in different soils. The natural processes following evaporation at the surface of the soil, from plant leaves, etc., cause an upward movement of soil moisture from the subsoil, and often from great depths. These solutions rising from below carry dissolved mineral plant nutrients; but when they reach the surface soil the strength of the solution there is not much increased, owing to a power of absorption or the fixing of these salts which the soil possesses. Thus the soil is in a sense "enriched" by these desirable constituents, although the actual feeding medium for the plant is not essentially altered. Similarly, artificial enrichment of the soil by commercial fertilizers does not materially affect the mineral composition of the soil solution, as is popularly supposed, but has other profound and far-reaching functions which our recent researches are now making clear.

It has been found that infertility in soils is very frequently due to the presence of bodies deleterious to plant growth, and the difficult task of isolating and identifying these bodies and studying their effects on plant growth has been undertaken in the work of this Bureau. Several of these substances have actually been removed from the soil and their properties determined. It has been shown that these bodies of organic origin result, under unfavorable soil conditions, from the decay of plant tissue, from excreta of germinating seeds, and from excreta of roots of growing plants. Under favorable soil conditions and under cultivation, proper drainage, suitable crop adaptations, crop rotations, and judicious use of fertilizers these organic bodies are absorbed or destroyed, providing a suitable and healthy environment for crops. Crop rotation is especially useful, since it has been found that the excreta of one plant are not necessarily deleterious to another kind of plant, and different species of plants themselves aid in the destruction and removal of deleterious organic substances. Of no less importance, because they are subject to better control, are the natural manures and artificial fertilizers. A rational use of these means of soil control, and especially of commercial fertilizers and soil correctives which now absorb so large a proportion

of our farmers' working capital, is the fundamental problem of present day agriculture.

It is most gratifying to be able to announce such substantial progress in the investigations of the real causes for the fertility or infertility of our agricultural lands.

TOBACCO SOILS.

As a direct result of the soil surveys and of the laboratory investigations, the possibility of producing a finer textured tobacco wrapper leaf in the Connecticut Valley was taken up, and it has been developed to a point where it is assured that a leaf approaching the Sumatra tobacco in texture, but with other local and distinctive characteristics, has been produced in the Connecticut Valley; and, largely as a result of the Bureau's work in Florida, the American-grown wrapper leaf has taken a foremost rank, is being exported to foreign countries, and is taking its place in real competition with the Sumatra leaf. The interest in this shade-grown product has grown to large proportions and the extension of this industry is contingent to a very large extent upon the soil surveys which shall point out the soils upon which this desirable leaf can be produced.

On certain soils in Texas and Alabama the Cuban type of leaf has been introduced as a direct result of the soil surveys, after a thorough examination of the soils and conditions of growth in Cuba, and as a result of demonstration work by the experts of the Bureau of Soils there are now hundreds of acres of land in both of these States producing the finest filler leaf, suitable for high-grade cigars.

Of so great importance has this work appeared that an informal application has been made by officials in Cuba for the extension of the soil survey to that country, to aid them in the further development and the better understanding of their own soils and the improvement of their tobacco industry.

In New York the reason for the variation in the type of tobacco has been found in the fact that the adaptation of the soils to the different varieties of tobacco has not formerly been understood or conceived, and the entire solution of the perplexing problem of the commercial crop in New York is now in a fair way of being solved by the utilization of the soil maps of the tobacco districts and the adaptation of varieties and of cultural methods to the soils suitable for particular commercial grades.

In Ohio the whole method of fermentation and handling of tobacco has been changed, with important results in the improvement of the crop and the prevention of the losses which occurred under the old methods of handling the leaf.

In Virginia not only has marked improvement in the grade of tobacco produced been shown to be possible by the Bureau's work, but by the proper handling of the soil through modern methods of culture and of fertilization the lands have been left in so much better condition after the tobacco crop has been removed that without further special treatment the yield of subsequent crops of wheat has been increased threefold and the lands have produced heavy crops of hay where formerly this crop was not even considered a possibility.

While the soil problems concerned in tobacco culture are receiving attention in the Bureau of Soils, to avoid any seeming conflict or duplication of work I have transferred all the cultural work in tobacco to the Bureau of Plant Industry for investigations on the

further improvement through selection of seed and breeding, while the Bureau of Soils will continue its soil survey and soil investigations of the important tobacco districts as a basis for continued improvement and a safe development of the whole specialized industry of tobacco culture.

PRACTICAL USES OF SOIL MAPS AND REPORTS.

Incidentally the War Department has on file a complete set of the soil maps thus far made, and is supplied, at its request, with copies of all soil-survey reports as soon as issued for the information of the military service in deciding on camp sites, on the character of the soils over large districts where they may be called to operate, and for other information that may be of importance in military plans.

The Post-Office Department is utilizing the maps to a considerable extent and frequently calls for advance copies for assistance in the location of rural free-delivery routes. Life-insurance companies and trust companies are availing themselves of the information contained in the soil-survey reports and maps in assessing risks and making investments of money. Nurserymen and seedsmen are availing themselves of the information furnished regarding the crops and fruits adapted to certain soils in certain localities. Plow manufacturers are utilizing this work to the extent of modifying farm machinery for adaptation to certain soils and certain regions to produce the most efficient work in cultivation.

By detailed soil surveys the Bureau is furnishing expert advice on the crop adaptations of the soils in those areas where irrigation schemes are effecting a change from extensively dry-farmed wheat ranches to intensively farmed fruit and alfalfa ranches.

In cooperation with the United States Reclamation Service, soil surveys are being made of the projects soon to be available for settlement upon completion of the necessary storage reservoirs and canals constructed by Federal effort. The soils of many of these projects have never been cultivated, and the newcomer to be successful must have the best information obtainable about the soils and the most profitable crops.

The soil survey reports, by calling attention to the soil resources and the opportunities offered to acquire good farm lands at a low figure, have frequently been of great assistance to the railroad companies in colonizing the territory in which they operate. Appreciating the value of the information contained in the reports, the railroads have in some cases arranged with the lithographic firms for specially large editions of the soil maps for distribution among prospective settlers.

Many large-scale detailed soil surveys have been made of experiment station farms and agricultural high school farms showing all of the minor differences in the soils of each farm. These soil maps have proved of great value in connection with the various plat fertilizer and rotation experiments conducted on the different farms.

Demonstration experiments on all the various kinds of alkali land found in the arid West have shown that the farmer need no longer dread alkali, but that such land can be easily reclaimed and made productive. The alkali problem has been satisfactorily solved and is in reality not as serious as many of the soil problems confronting the eastern farmer.

Special study of the viticultural soils in California has shown that there is a direct relation between the soil and the color, yield, and commercial value of the grape; that there are large bodies of soil very well adapted to various kinds of grapes, and that the grape industry can be greatly extended in many parts of California.

Soil surveys and special study have shown that there are large areas of soils in Arkansas and California that are peculiarly suited to rice culture and that the introduction of this crop will prove a boon to farmers owning such land that has hitherto been held to be of low agricultural value.

Investigations of the apple soils of California have shown that there is a close relationship between the keeping qualities of the apples and the various kinds of soils on which they are grown. This is very important and should prove of great value to apple growers in planting new orchards.

Soil surveys of swamp lands reclaimed generations ago as well as surveys and special studies of unreclaimed swamps in many States have shown the possibilities of swamp soils. The knowledge that some of these reclaimed swamp lands are still exceedingly fertile after one hundred years of constant cropping without fertilizers has helped arouse a general interest in the drainage of swamps. Again, the information brought out by the soil survey that certain swamps contain lands of low agricultural value shows the importance of a thorough knowledge of the soil and its possibilities before we can plan intelligently reclamation schemes involving the expenditure of large sums of money.

The results of the work of the Bureau of Soils have been presented directly to the people of the United States through the medium of educational tours conducted in ten different States. There have been held over 100 meetings for which the Bureau of Soils has contributed speakers to discuss the results of soil-survey work and methods of soil utilization and soil management. A great interest has been manifested in these meetings, and an opportunity has been afforded for answering many questions which were presented to the speakers in connection with this work.

The Bureau has assigned men to many localities in which soil surveys have been made to advise with farmers in regard to the character of their soils, the crops which may be grown to the best advantage, and methods of handling the soils to derive the greatest returns. The demand for this character of work is increasing as the number of completed soil surveys increases.

The fertilizer requirements of extensive soil types are being determined through laboratory and greenhouse methods and field observations in order to effect a saving in the fertilizer bill of the country.

Field investigations have been made to increase crop production on extensive areas of different soil types which, with the usual methods of cultivation, do not yield particularly remunerative crops. In many cases slight modifications of the methods of mechanical handling of the land increase the crop-producing power of such soils to a marked degree. Frequently tile drainage or the use of open ditches or other simple measures has been found sufficient. In other cases increased depth of plowing, change from spring plowing to fall plowing, the growth of cover crops to protect the land from washing during the winter rains, or the incorporation of organic matter with the soil

serves to render soils formerly held in little esteem of high producing value. This work is being developed as fast as possible.

The soil survey has found extensive areas of soils well suited to alfalfa culture, not only in Texas, but also in northern Mississippi and in central Alabama. It has been found that alfalfa soils occur in New York in localities where this industry has not yet been established, and in other Northern States as well. Upon some of these soils practically no other crop of high value is grown at the present time. The soil-survey work should be extended in order to outline more fully the localities where these soils exist. A special study should also be made of the preparation, the tillage, and the manurial requirements of these soils for successful alfalfa production.

The Bureau has materially aided in the development of the early truck and fruit industry in the Atlantic and Gulf Coast States. It has shown that there is a close relationship between the soils of different localities and the character of the truck crops which can be raised. The principal requirements of soils suited to early truck crops have been found to be small clay content, insuring excellent drainage and ease in cultivation and quick response to applications of fertilizers, and nearness to bodies of water, insuring freedom from frost. The soil survey has outlined large areas of land suitable for early truck and has been instrumental in the development of this important industry.

The Bureau is studying the characteristics of soils best suited to the production of the different varieties of cotton, notably the long staple and some of the improved varieties which are being used in an attempt to meet the boll-weevil conditions of the Southern and Southwestern States. Investigations have shown that types of cotton which grow to perfection upon loose sandy lands rapidly lose their essential characteristics if the seed from such cotton is planted on heavy clay soils or upon moist bottom lands.

Large areas of timber land have been cut over through a considerable portion of the South Atlantic and Gulf States and also in portions of the States bordering the Great Lakes. The proper use of these lands has not been well understood during the past, and it has frequently been maintained that with the removal of the timber these soils were of very small value. It has been found, however, that by the adoption of special methods of tillage, including the incorporation of organic matter and a moderate degree of fertilization, many of these soils are capable of producing the ordinary staple crops to good advantage. Some of these soils in the South Atlantic and Gulf Coast States have been found to correspond closely with the highly valuable truck and market-garden soils which have already been highly developed agriculturally.

Investigations have been made of the agricultural possibilities of the Piedmont section of the eastern United States. The rapid development of manufacturing interests throughout this section, with the accompanying growth of consuming population in the larger cities and towns, will soon render necessary the local production of such food supplies as are now to a marked degree shipped into these communities from remote localities. Changes from the production of staple crops to the production of special crops require careful study of the adaptation of soils to crops and the proper management of the soils and particularly of the application of fertilizers and

manures. In addition, many other cities of the central and southern United States are becoming aware of the necessity for the production of a large part of the perishable food supply of such cities in near-by districts. The importance of such investigations is emphasized by the marked growth of urban population as contrasted with a slight growth in rural population, or, in some cases, with an actual decrease of population in the farming districts.

Soil surveys have been undertaken in some of the New England States to determine the capabilities of lands which were formerly cultivated to corn, wheat, oats, and other grain crops, but which since have reverted to pasturage or have been altogether abandoned. It has been found that considerable areas of the rougher, steeper lands should be planted to seedling white pine trees, in order to insure a renewal of the timber supply of those sections, and that such an occupation of the rougher lands is probably the most desirable use to which they could be put. The more favorably situated soils can be profitably used for fruit and vegetable crops, which may be raised to advantage, and a ready market can be found among the summer resorts of this section of the country. The hill pastures of this section are well suited, under proper methods of cultivation and seeding, to the production of valuable pasture and forage grasses, by means of which the sheep industry may be reestablished throughout a considerable portion of the New England States. This would seem to be particularly desirable, as sheep do not require the extensive production of corn or other grain feed.

Careful study has been made in southern New York, northern Pennsylvania, and northeastern Ohio of approximately 10,000 square miles of hill and plateau belonging to a single soil series, over which the character of farming at the present time is not well suited to the soils or the climatic conditions. In this region there has been a continued tendency toward more extensive farming and away from specialization in crop production. In some cases attention has been called to the actual desertion of farm homes and to the coalescing of smaller farms into the larger holdings. This study has made evident the fact that the introduction of special crops, and particularly the adoption of proper methods of soil cultivation and soil fertilization, would make possible a more profitable system of farming. The present price of farm lands throughout this area is so low that these lands offer exceptional opportunities for the development of the orchard industry, animal husbandry based upon the production of grass and small grain crops, the production of white potatoes, and certain other specialties adapted to the general locality. These lands are located within a short distance of the greatest centers of population in the United States, and might be made highly productive and certainly remunerative with proper methods of crop adaptation and soil management.

SOIL EROSION.

In extending the principles and applications of American agriculture three steps are contemplated in the operations of the Bureau—education, individual action, and collective action.

The education need involve little more than diffusion of information on a few leading points, such as the magnitude of the annual loss due to soil erosion, the facility with which this can be checked, and the certainty that the remedy can be made not only inexpensive,

but actually profitable to each person applying it. Given this information, American intelligence and enterprise may be counted on to meet the occasion.

The chief individual action required is along the lines of improved agriculture, with more intensive methods, more thoughtful conservation of soil matter and crops and their by-products, more careful attention to ground water; and here, as elsewhere, public spirit is the strongest incentive to private conduct.

In general the collective action will develop materially with the growing knowledge of communities, yet it should be aided as needed by State and Federal instrumentalities. The keynote to such action sounds in the social principle that in the long run the good of the individual is the good of the community, and in the legal principle that each so use his own as not to injure others. The direct loss through soil erosion is very great and begins on each farm and affects every community. The indirect loss is no less, perhaps greater, for the streams are fouled, water power is jeopardized, navigation is impeded or prevented, and floods are raised; and since in the end the responsibility rests with the men on whose farms the evil starts, the remedy must begin with the farming community and should be guided by the interests of the whole people.

BUREAU OF ENTOMOLOGY.

Excellent results have been gained by the work of this Bureau in the course of investigations that have for some time been under way, and by order of Congress new investigations have been begun.

THE MEXICAN COTTON BOLL WEEVIL.

This very destructive insect has shown itself more adaptable to changed conditions, and therefore more capable of extending spread, than any other insect originating in the Tropics that has ever entered United States territory. It has established itself, contrary to anticipations, north of the line of early frosts, and there will probably be no climatic barrier to its spread throughout the whole cotton belt. Its northward and eastward spread has continued since my last report, and in the early autumn of 1907 it was found to have crossed the Mississippi River and to have entered the State of Mississippi.

Under the greatly changed conditions of soil and moisture existing in the bottom lands of Louisiana and Mississippi, the insect is changing its habits.

PARASITES AND NATURAL ENEMIES.

The careful studies that have been carried on have shown, however, that as the period of the occupancy of United States territory by the boll weevil lengthens the native parasites and natural enemies are becoming accustomed to it and are attacking it with increasing effectiveness year by year. It is now known that fifteen different insects which attack the boll weevil in its immature stages are at work in the infested territory, and the number is undoubtedly increasing. This is not a matter of small importance, since during the past season in a field near Waco, Tex., it was found that fully 40 per cent of the weevils had been killed by the combined work of several species of parasites. Practical results of parasite work are in sight, and in one experiment the mortality rate of the weevil was raised 9 per cent in two weeks by the introduction of parasites from one region to another where they were absent, or present in small numbers.

There are a number of species of weevils that attack native weeds, but which will not attack cotton. The parasites of these native weed-feeding weevils will attack the cotton boll weevil; and it has been found, after careful study of these insects and of their parasites, that where the natural food plants of the native weevils are destroyed about cotton fields at a certain time, the parasites of these weevils, in the absence of their normal food, will attack the cotton boll weevil to such an extent as very considerably to increase the mortality of the boll weevil. The native fire-ant, occurring throughout the cotton belt, is rapidly acquiring the habit of feeding upon the boll weevil. In one case, at Beeville, Tex., where the boll weevil has been known for at least twelve years, during the past year in a certain field three-fourths of the weevils in fallen squares were found to have been destroyed by this ant. Careful studies have been made and are now being made of the special conditions favorable to the increase of this ant and of the different parasites, and it seems very probable that practical results will follow.

FIELD EXPERIMENTATION.

As in preceding years, a number of large-scale experiments in different regions where the weevil problem assumes a local aspect were carried on. Nearly 1,000 acres, in lots varying from 10 to 65 acres in extent, were used in this work.

Most important results have been gained in a test of the efficacy of the fall destruction of cotton plants. In one isolated locality in Calhoun and Jackson counties, Tex., badly infested with the weevil, 410 acres, comprising all of the cotton in that vicinity and separated from other cotton plantings by about 10 miles, were cut during the first ten days of October, 1906. In Lavaca County, 30 miles away, a considerable quantity of cotton is grown at Six Mile Settlement. This cotton was not destroyed, and the fields were kept under observation as a check. The results were as follows:

In May, 1907, in the experimental fields only one weevil was found, whereas in the check fields practically all of the squares had been destroyed. In September, 1907, the cotton in the experimental fields showed a yield of about 1,000 pounds of seed cotton per acre, while in the check fields the average was about 350 pounds of seed cotton per acre, and this in spite of the fact that the soil on the check area is much richer than that in the experimental area. The destruction of the plants in October has caused the poorer land to produce practically three times as much cotton as the richer land. The proper treatment of the fields in the experimental area resulted in an advantage to the farmers of $20 per acre.

The result is that by systematic fall destruction of cotton plants boll weevil damage can largely be averted, the reason being that by such destruction many millions of weevils in one stage or another are killed which otherwise would successfully pass the winter and infest the next year's crop.

OTHER COTTON BOLL WEEVIL WORK.

Extensive experimentation on the hibernation of the weevil was carried on; many laboratory observations and experiments were made; careful tests were made of all recommendations and suggestions that contained any element of probable success; the question

of late planting versus early planting was again tested, with the result of a perfect proof of the fallacy of the late-planting idea; and a machine was devised for the destruction of the insect in fallen squares which bids fair to be of considerable value. The northward and eastward spread of the weevil was carefully watched and predictions of damage were issued from time to time. The results published in June, 1907, indicated that the damage to be expected from the boll weevil during the year would be much less than normal. This prediction was verified by the later results.

The work in cooperation with the State experiment stations was continued. One man was detailed to the Texas Experiment Station and three to the Crop Pest Commission of Louisiana, which is virtually a part of the experiment station organization in that State.

WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

During the past fiscal year work against these two destructive insects in New England was taken up under a special appropriation by Congress. Headquarters were established in Boston; a skilled agent was placed in charge; a large force of laborers was engaged, and energetic work was begun as soon as the appropriation became available. Under the terms of the appropriation the work has been directed toward preventing the further spread of the gipsy moth and the brown-tail moth, and the work has been largely concentrated upon the gipsy moth, for the reason that it can more readily be handled and spreads much more slowly, owing to the fact that the female can not fly and the species spreads largely by the accidental carriage of the caterpillars on vehicles of different sorts and by pedestrians. The brown-tail moth flies readily and its range is much greater than that of the gipsy moth. It is easily destroyed in the winter time by the destruction of the winter nests, and an educational campaign in cooperation with the States of Maine, New Hampshire, Massachusetts, and Connecticut has been undertaken with a view of inducing property holders to accomplish the destruction of this species on their own grounds. With the gipsy moth the effort has been to destroy the insect along the main traveled roads for a distance of 100 feet or more back from the roads, thus preventing the caterpillars from spinning down from overhanging trees upon vehicles passing by. This work was started in the main centers of infestation, since these are the principal sources from which the insects are disseminated.

Such roads in 11 towns in the most thickly infested portions of Massachusetts have been cleared up, and at the present time conditions are vastly improved. In the meantime careful scouting has been carried on around the borders of the territory known to be infested, with the result that the gipsy moth has been found in many places in southern New Hampshire and at a large number of points in southwestern Maine, where it was heretofore unknown to exist. The States above mentioned and the State of Rhode Island have passed laws and have appropriated comparatively small sums of money to be used in the fight against the gipsy moth and the brown-tail moth, and conditions are such in Maine, Rhode Island, and Connecticut that the object aimed at is the extermination of the insects. The fall scouting of 1907, so far as it has as yet developed the situation, seems to show that in Maine the insect has secured a much greater foothold than was formerly supposed, but nothing has thus

far developed to render extermination impossible. In New Hampshire scouting work is now going on, and since all of the colonies of the gipsy moth so far found are in orchards or along roadsides, and not in the forests, it is not improbable that extermination may be accomplished in that State. The condition as a whole is encouraging, and it is quite possible that the gipsy moth will be prevented from any further dangerous spread and at the same time can be greatly reduced in numbers. In Rhode Island, for example, the past year's work has resulted in the destruction of 95 per cent of the insects.

INTRODUCTION OF BENEFICIAL INSECTS.

PARASITES OF THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

The introduction of the parasites and predatory insect enemies of the gipsy moth and the brown-tail moth referred to in my last report has been continued with great success, and it is reasonably certain that the gipsy moth, as shown in the preceding paragraph, can be held in check by mechanical means until these imported natural enemies shall bring about a condition such as exists in Europe, where this insect only rarely appears in great numbers and then only for a single season.

In the early summer of 1907 the Chief of the Bureau of Entomology again visited parts of Europe, extending the range of his search for parasites into central and southern Russia, and by cooperation with European entomologists succeeded in introducing a much larger number than ever before of European parasites of the eggs and of the larvæ and pupæ of both the gipsy moth and the brown-tail moth. Two new species of primary parasites were introduced from Russia, and one of these proves to be a very rapid breeder and promises the best results.

These insects have been cared for in large indoor and outdoor breeding cages in the vicinity of Boston, and many thousands of specimens have been liberated in the open. There is abundant proof that several species have established themselves, and there is every reason to suppose that they will breed with greater or less rapidity. It is hoped that the results of the work of these parasites will be evident by the summer of 1909, and there is a possibility that they may be evident in 1908.

The life histories and habits of these parasites are being studied by expert assistants in the laboratory near Boston, and careful observations at the same time are being made by agents of the Department in France and in Russia. Aside from the new species imported from Russia, the most encouraging feature of the year's importations is probably the abundance of parasites of the eggs of both the gipsy moth and the brown-tail moth that have been brought to America. Six generations of one species have been followed through during the past summer.

Altogether 35 species of these beneficial insects have been imported. Of these, 14 are hymenopterous parasites, 16 are dipterous parasites, and 5 are predatory beetles. There have been colonized in the open 9 species of hymenopterous parasites, 14 of dipterous parasites, and 2 of predatory beetles, making 25 species in all. Certain evidence of the practical acclimatization of a number of these forms has been gained.

OTHER IMPORTATIONS.

Aside from continued importations of several species of European ladybirds, which are effective enemies of plant lice and other soft-bodied insects, a systematic effort has been begun to import and acclimatize the European parasites of the codling moth. The State Board of Horticulture of California has already imported one parasite of this destructive insect and has it breeding in confinement at Sacramento, but the California organization has refused to distribute this parasite in other States except for large cash payments. The Department is therefore making the effort for the good of the whole country and will introduce not only a single parasitic species but as many as possible. Several hundred cocoons of the codling moth have already been received from different parts of Europe and are being cared for in the insectary of the Department at Washington.

What may prove to be an important egg parasite of the imported elm-leaf beetle has been discovered in France, and infested egg-masses have been sent to this country in the hope of establishing the parasite on this side of the ocean. This year's sendings were started too late, but in view of this experience it is hoped that next season this parasite may be brought over successfully.

THE SENDING OF USEFUL INSECTS ABROAD.

As indicated in previous reports, European officials have been so generous in their assistance to this country in these importations of beneficial insects that the Department has endeavored to return the courtesy wherever possible. Continued sendings of scale-insect parasites have been made during the year to Italy with promise of success.

An interesting cooperative experiment was begun during the year with the French Government, and successful sendings of a predatory wasp from the Southern States to Algeria were made. On arrival in Algeria these wasps were cared for by agents of the Pasteur Institute of Paris, acting for the French colonial government, in the effort to establish a species which will destroy the gadfly, which carries a very destructive disease of the dromedary, so important in that country as a beast of burden.

FIELD-CROP INSECTS.

During the year the investigations of the Hessian fly and the different species of jointworms have been carried on, and work has been done with the so-called green bug which injures grain in the West in the early part of the season.

HESSIAN FLY INVESTIGATIONS.

The wheat-sowing experiments have been increased during the year, and are now being carried on in eleven States, over 800 different sowings having been under constant observation this year. Exact data are being continually accumulated, showing that it is possible to evade the most serious portion of the fall attack of the fly by seasonably late sowing in the fall, and exact dates under certain conditions for the different localities are being gradually established. These experiments, acting at the same time as demonstrations, are

attracting much attention and are carefully watched by the farmers throughout the sections where the experiments are located.

An important branch of the Hessian fly work has demonstrated the possibility of the practical use of the parasites of the fly, and this is brought about by the careful study of the experimental sowings. A striking example has developed during the year. Early sown plats at Lansing, Mich., and Marion, Pa., were seriously attacked by the fly, but when examined at a later date fully 90 per cent of the flaxseeds were found to have been stung by a certain species of parasite and to contain its developing larvæ. At this time a field of wheat near Sharpsburg, Md., was found to be infested by the fly and examination indicated the absence of parasites. On April 8 some thousands of the parasitized flaxseeds from Pennsylvania were brought to Maryland and placed in the field. On July 8 an examination of the Maryland field showed that the parasites had developed so rapidly as to bring about an almost total destruction of the fly.

INVESTIGATIONS OF THE SO-CALLED GREEN BUG.

A destructive outbreak of this insect was carefully studied by several expert assistants. It began in Texas in January, and then consecutively in the States to the North, until it finally appeared across the Canadian border. Many remedies were tried, and a large-scale experiment was carried out in the carriage of early developing parasites from the South to more northern localities, liberating them in infested fields. Important results were obtained, and it was apparently shown that under the conditions under which the experiments were made this year there is little or nothing to be gained by such transportation of parasites, since they develop almost simultaneously in northern fields into which southern parasites have not been introduced. Further experimentation of this kind, however, must be carried out before exact conclusions can be announced.

JOINTWORMS AND OTHER GRAIN INSECTS.

Experimental work with the wheat jointworm and the timothy jointworm has been continued, and it has been shown that a proper rotation of crops will practically prevent damage by both insects. Further investigations have been made on the seed-corn ground beetle and the corn-root aphis and a number of other insects belonging to this group.

WHITE FLY INVESTIGATIONS.

By order of Congress, and under a special appropriation in response to strong demands from the Florida citrus-fruit growers, an investigation was begun on the white fly, an insect which does great damage to orange and lemon groves. A special agent with ample assistance was located in Florida, and life history studies have been made, experiments carried on in the introduction of parasitic insects, and in the encouragement of fungous diseases, and also in the control of the insect by the use of insecticides and gases. Much information of distinct value has resulted. Parasites of native insects of the same family have been brought from different parts of the country, and some results have been obtained which indicate that in the more humid portions of Florida the fungous diseases of the insect may be encouraged. The thorough investigation of the use of liquid sprays

has progressed, and experiments in the use of hydrocyanic-acid gas indicate that under favorable conditions—that is, isolation from other infested groves, or where concerted action can be had—fumigation is much more economical than spraying and much more certain in its results than reliance on natural enemies.

INSECTS AFFECTING TOBACCO.

In the bill making appropriations for the Department for the present fiscal year a clause was inserted providing for investigation of insects injurious to tobacco in the dark tobacco belt of Tennessee and Kentucky. An expert assistant was sent to the region late in May, 1907, to make a preliminary examination of the field. Studies were made of the tobacco flea beetle, which seems to have been especially injurious this year, of cutworms, of plant lice, and of a few other species. Experimental plats at two important points were arranged for and cooperation with the Tennessee and Kentucky experiment stations was also arranged. A permanent special agent was placed in the region in question, and his work is now well under way.

INSECTS DAMAGING DECIDUOUS FRUIT TREES.

In addition to the continuation of investigations already in progress, an important new project has been taken up, namely, the study of the pear thrips and other deciduous fruit insects in portions of California. A station has been established at San Jose, an expert has been placed in charge, and the destructive pear thrips is being studied with the greatest care.

The plan of maintaining field stations in parts of the country devoted to the growing of deciduous fruits on a large scale has proved to be an excellent one, and in this way it has become possible to thoroughly study the insects being investigated under perfectly normal conditions and to conduct tests of remedies on a commercial scale. This work and the tests of insecticides is carried out according to a uniform plan, and thus shows variations in the life and habits of a given species in different parts of the country and what changes should be made in the use of remedies.

To the work in Pennsylvania has been added an investigation of the destructive grape rootworm. Demonstration spraying in the control of the codling moth and apple disease in cooperation with the Bureau of Plant Industry has been carried on at several points, and the work upon the plum curculio and the peach tree-borer, as well as that upon the San Jose scale, especially in the investigation of different washes, has been continued.

BEE CULTURE.

The chief problem taken up in this work was the investigation of the brood diseases of bees, and a bulletin on this subject was prepared and published. Careful bacteriological work has been done on these diseases and a number of obscure points have been cleared up.

Work on bee paralysis, a disease of adult bees, has been carried on by an agent in California. This is a most obscure disease, and no evidence of the influence of a micro-organism has as yet been found.

Distribution of breeding material of the various known races of bees has been carried on, and work on experimentation with honey-producing plants has also been continued.

An interesting series of tests has been begun as to the comparative value of the various races of bees in fertilizing red clover.

SILK CULTURE.

No changes have been made in the methods that have been followed for some years past in the effort to continue the production of silk in the United States. Eighty-five ounces of tested eggs were imported from Italy and distributed to 343 applicants in the spring. About 11,000 seedlings of the best white mulberry were also distributed. Cocoons were purchased from American growers at a rate varying from 90 cents to $1.15 per dry pound, and these cocoons were reeled at the Department. The reeled silk on hand was sold during the year at $4 a pound, bringing in a return of $1,012, which was deposited with the Treasury Department in compliance with the regulations.

INSECTS INJURIOUS TO VEGETABLE CROPS.

In the course of the year the investigations of insects of this class have been continued with a larger force than ever before, and some excellent results have been obtained. For example, in a series of cooperative investigations made between the Bureau and the Texas Agricultural Experiment Station on the melon aphis, great success has been obtained in the elaboration of remedial measures and in the demonstration of their efficiency. Especial attention has been paid to insects injurious to truck crops in the South, the region from which the early vegetables are sent to the northern markets.

Investigations of sugar-beet insects have been continued, and a full report upon the beet leaf-hopper, which has been very destructive in Utah and Idaho in recent years, is practically completed.

INSECTS INJURIOUS TO FORESTS.

In this direction very satisfactory progress has been made both in acquiring and diffusing information of practical value to the forest interests of the country. Especial work has been done upon insects that prevent forest reproduction, and those injurious to forest products, both crude and finished. Damage done by powder post beetles to finished hardwood material has been investigated with the result that successful methods of control have been ascertained. Studies have been made of beneficial forest insects looking toward their practical utilization. The studies of the damage by bark beetles to coniferous trees have been continued, and recommendations of the Bureau have been adopted with excellent results.

INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

The work of the Bureau on the subject of mosquitoes has been continued, and a complete account of the mosquitoes of North America, including some consideration of their relations to disease, is nearly finished.

The investigation of the life history of the Texas cattle tick and other injurious ticks which may be concerned in the transmission of disease has been continued in cooperation with different State entomologists, and many important points having a direct bearing upon methods of control have been ascertained. A true parasite of one

of the ticks has been found which offers hope that natural methods of decreasing the abundance of ticks may yet be learned.

OTHER INVESTIGATIONS.

Elaborate work on the destructive group of scale insects has been carried on through the year. Insects injurious to stored products have been further studied. Elaborate tests of different insecticides have been made, and radical inspections have been made of all of the plant material introduced by the Department and sent out, so that the danger of spreading insect pests in this way is practically removed. Investigations of the insects affecting the pecan in the South have been begun.

BUREAU OF BIOLOGICAL SURVEY.

Practically all the investigations under way in the Bureau of Biological Survey at the time of the presentation of my last report have been continued and additional and important lines of work have been begun.

ECONOMIC VALUE OF BIRDS.

The education of the public as to the value of birds generally and the part they play in the economy of nature is felt to be an important part of the duties of the Survey. School children especially need enlightenment, both as to the value of birds and as to the duty of the citizen toward them. During the last year circulars have been issued with this important educational end in view.

ECONOMIC INVESTIGATIONS.

THE BOLL WEEVIL.

Work in relation to the ravages of the boll weevil was continued in Texas and Louisiana with gratifying results. Several additional birds were found to feed on the weevil, bringing the number of species now known to prey on it up to 43. A report detailing the results of the season's observations has been published, and it is hoped that its wide dissemination in the cotton States will have two important results: (1) The enactment of necessary protective legislation for several species of birds not now protected; (2) the enlightenment of all classes of citizens in the cotton States as to the important part certain birds play in limiting the ravages of the pest, and also the enlistment of their cooperation in protecting and in increasing the numbers of the birds that destroy the weevil. That the latter is entirely practicable can not be doubted, at least in the case of swallows, which are among the most persistent enemies of the weevil. While these useful birds are under protection of law in the Southern States as elsewhere, it has been ascertained that in certain districts their nests are broken up and the birds driven away or destroyed, under the mistaken idea that they harbor insects obnoxious to man. Such is not the case, and it is believed that if wide publicity is given to the facts the birds, instead of being persecuted, will be encouraged, as they should be, to build in every available site. A substantial increase of numbers would enable them to wage more effective war against many injurious insects, including the worst offender of all, the boll weevil.

BIRDS IN RELATION TO FRUIT RAISING.

For several years work has been conducted in the fruit regions of California to determine the exact status of birds in their relation to this great and growing industry. The vicinity of orchards is known to be a favorite home of birds, but by no means all the birds that nest in and about orchards are attracted by the fruit. On the contrary, numerous species choose orchards as their home, or as their hunting grounds, because of the multitude of insects which infest fruit and fruit trees. Careful examinations of the stomachs of orchard birds show that by the destruction of injurious insects most of the birds that eat fruit more than compensate for the damage they do. The moderate amount of fruit consumed by such species may properly be looked upon as pay for services rendered, and it may be added that the service is cheaply bought. In the case of certain species which are harmful to the fruit growers' interests remedial methods are suggested.

SCALE-EATING BIRDS.

Special investigations have been made to determine the extent to which birds prey on scale insects. These dangerous pests are so small and so sedentary that they have been generally supposed to be overlooked by birds. Such proves to be by no means the case, and no fewer than 57 species of birds have been ascertained to feed on scales. Moreover, certain birds, the grosbeak, for instance, appears to have a special fondness for them and to hunt them assiduously.

TRAFFIC IN CAGE BIRDS.

The fact that 300,000 cage birds are yearly imported into this country and that the number is constantly increasing will surprise many. By far the greater number of these importations are canaries, or other cage birds. There seems to be no reason why most if not all the cage birds required in this country should not be raised here. The industry is very profitable in Germany and elsewhere abroad, where it is carried on, not in a wholesale way, but by the women and children of individual families who, with comparatively little labor and trouble, add an interesting occupation to their ordinary household duties and secure satisfactory returns in cash. The mountain regions of the Southern States, particularly, would seem to furnish almost ideal conditions for such an industry, which, besides being lucrative, possesses the added advantage of substituting domestic birds for such wild species as the mocking bird, cardinal, and nonpareil, whose value to agriculture is too great to make it desirable to confine them in cages.

DUCKS AND SHORE BIRDS.

In the past one of the important food sources of the United States was its game, particularly its ducks, geese, and shore birds, thousands of which found their way to the markets of all our large cities to be used for food by rich and poor. Unfortunately the natural supply of these birds was not wisely husbanded with an eye to the future, but, as in the case of the buffalo and wild pigeon, was mercilessly pursued till at the present time not a few species are threatened with speedy extinction. The subject is important, and it is obvious that if the more desirable species of ducks and geese are to be preserved for the future, additional legislation is needed. The essential

data to serve as a basis for legislative action are a knowledge of the food supply and of the pairing times of the several species of ducks, geese, and waders; and of the routes they pursue in migration. These subjects are now being carefully investigated.

ECONOMIC MAMMALOGY.

It is with a view to the discovery of more effective and cheaper methods of destroying rodents that experiments with contagious diseases have been continued in cooperation with the Bureau of Animal Industry. A very important field for this work is among the small ground squirrels of the Northwest, where these animals annually destroy vast quantities of grain. Laboratory experiments have yielded promising results, and work along this line will be continued with the hope of securing a virus which can be utilized in reducing the number of rodent pests throughout the affected area.

THE RABBIT PEST.

Complaints of damages to orchards and various other crops by rabbits continue to be received. Experiments were continued during the past year with a view to the discovery of a protective wash for fruit trees, and excellent results were obtained with the lime-and-sulphur wash, well known as a remedy for the San Jose scale. The wash can be made in quantities very cheaply, and it seems to protect fruit and other trees perfectly from the attacks of both rabbits and mice. It is also durable in effects, one liberal application lasting all winter. Should further experiments confirm the efficacy of this wash as a protection for trees against the attacks of small rodents, an important problem will have been solved, as the annual destruction of orchard trees by rabbits and mice reaches large proportions.

HOUSE RATS.

No one of our wild mammals, possibly not all combined, does so much damage as the common rat. Many experiments have been made to discover satisfactory methods of checking the depredations of these animals and of reducing their numbers. A bulletin setting forth the most approved methods known was issued during the year with the expectation that it will materially aid in the protection of property from the attacks of these pests. Meanwhile experiments with bacterial diseases are being continued for the purpose of discovering a safe and effective virus, fatal to these rodents and yet harmless to domesticated animals.

FIELD MICE.

Though small, field mice are so generally distributed over the United States and so numerous in certain regions that they often do great damage in gardens, meadows, nurseries, and orchards, where they attack fruit trees and crops. Alfalfa is particularly relished by these rodents, and, as it is very nutritious, when once they have invaded a patch they increase enormously. As in summer they attack the foliage and in winter the roots, if unchecked they soon destroy whole fields and render fresh planting necessary. They thus possess considerable economic importance. A careful study has been made of their habits and such methods of prevention suggested as have been found most efficacious are set forth in a bulletin which is now being widely distributed.

WOLVES.

Methods of destroying wolves that prey upon stock on the western ranges have been carefully studied and two reports on the subject were issued last year—one, in cooperation with the Forest Service, in relation to the destruction of stock on the western ranges; the other in connection with the destruction of deer in Michigan and Wisconsin. The adoption by stockmen of the methods recommended—especially killing the young in the breeding dens—has already resulted in a material reduction in the number of wolves and a corresponding saving of stock and game.

GAME PROTECTION AND INTRODUCTION.

ENTRY OF FOREIGN BIRDS AND MAMMALS.

The act of Congress of May 25, 1900, prohibiting the entry into the United States of the mongoose, English sparrow, flying fox, and starling has now become so well known that for the past two years none of these pests has been offered for entry, nor has constant vigilance disclosed any attempt to introduce them surreptitiously.

The importance of a check upon the possible introduction of pests into the United States grows with the growth of the trade in cage birds, which is increasing very rapidly. During the year, besides 708 mammals, 408,532 birds were imported under permit, an increase of 27 per cent over those of the preceding year and 51 per cent over those imported in the year ending June 30, 1905. Of this large number, 351,407 were canaries. Nearly all were entered at New York and Philadelphia, and all but a comparatively small number were subjected to careful inspection by the Department's representatives at those ports. In addition to its value as a means of preventing the introduction of injurious species, the service presents features of more than ordinary interest in revealing the extent and character of a trade concerning which little has been generally known.

Its usefulness further appears in the fact that it keeps the Department informed of the importation of foreign game birds for the purpose of stocking American covers. Our own game birds are constantly diminishing in abundance, and the practice of introducing foreign birds as a substitute grows in favor. Many species, serving both for food and sport, have already been more or less firmly established in various parts of the country. During the year Illinois imported more than 1,000 European partridges, and Kansas imported about 2,000 English pheasants. Capercailzie and black game of northern Europe, the former of which is nearly as large as wild turkey, have been imported successfully for liberation at various points, notably on Grand Island, Michigan, and in the Algonquin Park, Ontario.

The experiment of stocking covers by means of imported eggs of game birds also is apparently meeting with favor. Under the act of June 7, 1902, every such consignment requires a permit from the Department. More than 5,900 eggs were imported during the year. In number this was but a slight increase over those brought in in 1906, but the fact that they were imported in 39 different consignments, as against 5 in the preceding year, shows a much more widespread interest.

INTERSTATE COMMERCE IN GAME.

The most important feature in the suppression of illegal interstate commerce in game was the arrest of two noted tusk hunters, and the confiscation of a large quantity of hides, horns, and teeth of elk they had secured in the Yellowstone Park and vicinity. The men involved in this particular transaction were tried for a violation of the Lacey Act in shipping their plunder from Idaho to California. They pleaded guilty and were promptly fined $200, the minimum penalty under the Lacey Act. It is greatly to be regretted that the demand for the heads, horns, and especially the tusks of elk, should threaten the extinction within our territory of this noble game animal, and every effort should be made by National and State authorities to protect the few remaining head. The high price paid for trophies, especially the teeth, is an incentive to pursue the animals. The practice of hunting elk has been conducted with disregard of the Federal and State laws, and has been very destructive.

Attention is called again to the importance of additional supervisors to be stationed at central points to represent the Department in its efforts to abolish unlawful interstate commerce in game. It is impossible for the Department to secure adequate enforcement of the Lacey Act without increase of its force. Local conditions must be studied, evidence must be secured, and it is often essential, as with other branches of the Government service, that the Department be represented at the trials of important offenders. The cost of such additional force would be slight and the benefit very great.

BIRD RESERVATIONS.

No new reservations were established during the year, but the seven already created were maintained under careful supervision. Some poaching was reported by the warden of Stump Lake Reservation, in North Dakota, but as three of the poachers were arrested, promptly convicted, and fined $25 each, the example will probably have a deterrent influence.

PRESERVATION OF GAME IN ALASKA.

During the last session of Congress a bill was introduced placing the duty of issuing permits for the export of trophies and specimens from Alaska with the governor of the Territory, instead of with the Department, and providing for the issue of licenses. The bill, however, failed of passage, and for the present the Department will continue its conservative policy in regard to the issue of export permits. I am impelled to renew my recommendation that Congress relieve the Department of the duty of enforcing the Alaska game law. The present law is unsatisfactory, both to the residents of Alaska and to this Department.

COOPERATIVE WORK.

Much attention is given to cooperative work, chiefly in connection with the establishment and maintenance of efficient game and bird protection in the various States. Special aid was given to Alabama, California, Connecticut, Delaware, New Jersey, New York, Pennsylvania, Tennessee, Texas, Vermont, Virginia, and Wisconsin. Requests for such aid are of increasing frequency, but are complied with

so far as possible. They involve chiefly explanations to legislatures, or legislative committees, of certain special features of game protection, and of assistance in cases arising from violations of game laws.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

To appreciate properly the present importance of this Division and the rapidity with which its responsibilities are increasing it is only necessary to consider the growth of the Department as a whole, as shown by the appropriations for agricultural investigations and related purposes since its inception in 1839. In that year $1,000 was set aside by Congress " for the purpose of collecting and distributing seeds, prosecuting agricultural investigations, and procuring agricultural statistics." In 1849 the appropriation had increased to $3,500 and in 1859 to $60,000. In 1862 the importance and value of the work, until then prosecuted under the direction of the Commissioner of Patents, had secured such recognition that a department headed by an independent Commissioner was created for its continuance. In 1869 the agricultural appropriation amounted to $172,593, in 1879 to $206,400, and in 1889 to $1,034,480, by which time the administration of the financial affairs of the Department had developed such importance that a separate division became necessary to insure proper disbursement of the funds set aside by Congress for the needs of the Department. In 1899 the annual appropriation had increased to $2,829,702, but during the past ten years the growth of the Department has been rapid and the benefits to the public have increased correspondingly. The regular appropriation bills of the Department for ordinary and routine expenses from 1903 to 1908, inclusive, show an average annual percentage of increase of 12.9.

The amount estimated for the fiscal year ending June 30, 1909, in the regular appropriation bill is $10,666,351, which includes $720,000 for agricultural experiment stations. This is an apparent increase of $1,459,061, or 15.8 per cent; but, taking into consideration the loss of revenues derived by the Forest Service from the sales of timber, etc. (estimated at $1,500,000 annually), which heretofore have been used for maintenance of the reserves, but which, beginning on July 1, 1908, are required by law to be deposited in the Treasury to miscellaneous receipts, it is in reality no increase. In addition there will be a permanent appropriation of $3,000,000 for meat inspection, and an item of $550,000 in the sundry civil bill for printing and binding for this Department, to be done under the Public Printer, making a grand total of $14,216,351.

During the fiscal year ending June 30, 1907, the Congressional Committee on Expenditures in the Department of Agriculture carefully investigated the expenditures for the preceding fiscal year. In the course of this investigation all the higher officials of the Department appeared before the committee and under oath explained in detail the character and object of the various lines of work being prosecuted by the Department. It is gratifying to state that as a result of the examination every penny of the agricultural appropriations was properly accounted for, the work and discipline of the Department received high commendation, and it was shown that the annual value of the Department of Agriculture to the general public at the present time is nearly a quarter of a billion dollars. As the annual

appropriation for the Department is about $14,000,000, it will be seen that this is a return of about $16.50 for every dollar appropriated by Congress.

For the prosecution of the various activities of the Department of Agriculture during the year ending June 30, 1907, including the permanent appropriation of $3,000,000 for meat inspection and other special appropriations, Congress appropriated the sum of $11,557,691.36, this amount being $4,382,001.36 in excess of that similarly appropriated for the preceding year. The disbursements of the Department during the fiscal year 1907 amounted to $8,586,209.23, and the greater part of the balance of $2,971,482.13 will be required for the settlement of outstanding liabilities.

The amount paid for rent of buildings in the District of Columbia in the several branches of the Department was $50,148.96.

All accounts for the fiscal year 1905 having been settled, the unexpended balance of appropriations for that year, amounting to $74,336, was covered into the Treasury on June 30, 1907. The account for the fiscal year 1906 is still open.

DIVISION OF PUBLICATIONS.

The results of the investigations conducted by the Department are made known and become available for the use of the people by means of publications, of which 1,415 were issued during the year, 596 being new and 819 reprints. These publications comprised 52,363 printed pages and the total number of copies aggregated 16,746,910, an increase of 3,258,889 copies over last year.

The publication work of the Department has assumed such magnitude that only by the most careful editorial supervision and by the enforcement of the most rigid economy in the printing and by the exercise of constant discretion in the distribution of the documents has it been possible to accomplish the results attained with the present appropriation. It has become absolutely necessary to reduce the editions of the scientific and technical publications to sufficient numbers to supply only restricted lists of cooperators, educational institutions, experiment stations, and libraries, and to refer miscellaneous applicants to the Superintendent of Documents, who, under a wise provision of law, is authorized to reprint our publications and sell the same at a nominal price so long as there is a demand for them. The fact that last year 71,764 copies of various publications of this Department were sold at an aggregate price of $10,885.20 is indisputable evidence of the willingness of applicants to purchase publications in which they are interested and thus to contribute toward the support of the publication work of the Department. If the publications could be placed on sale at the post-offices throughout the United States, and thus made easily procurable, I feel confident that the people would buy them. In this way the wide dissemination of the practical information they contain would be insured, which is not possible under the system now in vogue and with the funds available for printing and binding.

FARMERS' BULLETINS.

Farmers' Bulletins continue to be the most popular publications of the Department. Forty-two new bulletins were issued during the year, the number of copies printed being 1,100,000, while 443 reprints of

bulletins were made in editions aggregating 5,369,000, the total number of Farmers' Bulletins printed in the year being 6,439,000 copies, of which 3,484,713 were distributed upon the order of Senators, Representatives, and Delegates in Congress. The fund appropriated for the preparation and printing of these bulletins remains at $98,750, which is inadequate to print the number required, and I have asked for $125,000 for next year, with the view to increasing the number allotted to each Senator, Representative, and Delegate in Congress to 15,000 copies and to enable the Department to supply the increasing demand for these publications. The total number of Farmers' Bulletins printed and distributed since the series was created in 1889 is 55,125,000, of which 37,400,161 have been distributed by Members of Congress.

PUBLICATIONS SPECIFICALLY AUTHORIZED BY LAW.

There are nine publications of this Department the annual printing of which is specifically authorized by law. Under the provisions of Joint Resolution No. 14, approved March 30, 1906, it is permissible to order any part of the edition instead of the total number of copies specified. The Department has availed itself of this provision, and instead of printing the greatest number allowable, which was 68,000 copies, only 46,100 were ordered, thus effecting a saving of $15,000.

WEIGHING THE MAIL.

In accordance with a provision of the act making appropriations for the Post-Office Department for the fiscal year ending June 30, 1907, the Division of Publications weighed carefully the mail forwarded through the post-office under penalty envelopes during the first half of the fiscal year, the results of which are interesting, inasmuch as the principal distribution of the publications of the Department is made through this Division. The record shows that during that period 3,698,725 packages, weighing 622,988 pounds, which would require at ordinary postage rates $66,450 to provide stamps, were delivered to the city post-office. An accurate account of the entire year's distribution can not be obtained by doubling these figures, as the demands for the Department's publications during the last half of the calendar year are not so great as during the winter and spring months. Therefore it is a fair estimate to place the weight of the domestic mail forwarded by the Division of Publications at more than 1,500,000 pounds. In addition, there were mailed to foreign countries, prepaid by postage, 44,426 packages, weighing 14,426 pounds 13 ounces, at a total cost for postage of $1,474.98; and 134 packages, weighing 508 pounds 4 ounces, were forwarded through the Bureau of International Exchange, Smithsonian Institution, as the weight of each package was in excess of the limitations imposed by the foreign countries to which they were mailed. Furthermore, there were forwarded to the Dominion of Canada, Mexico, and Cuba, under the frank, 15,909 packages, weighing 3,972 pounds. Many of the publications thus forwarded were sent by registered mail. A card index is kept of the distribution of the more important bulletins and reports, and a careful record is kept of every publication distributed, the Division of Publications being charged with this distribution under the provisions of the act of January 12, 1895.

TO FACILITATE THE REPRINTING OF OUR PUBLICATIONS BY THE AGRICULTURAL EXPERIMENT STATIONS.

There is a growing desire on the part of the agricultural experiment stations to distribute publications of this Department, especially those that relate to subjects in the investigation of which there has been cooperative work. Unfortunately the Department fund is insufficient to permit the printing of the copies desired for distribution by the stations. I strongly recommend some modification of the law of January 12, 1895, relating to the public printing and binding, which would authorize the Public Printer to sell at reasonable prices to the directors of the agricultural experiment stations electrotype plates of the publications of the Department. This would enable the stations to reprint at small expense any publication of this Department, thus insuring a wider dissemination of the information contained in our publications than is possible with the present appropriation for printing.

BUREAU OF STATISTICS.

METHODS OF CROP REPORTING.

The general plan of the crop-reporting service has not undergone material changes during the past year. Efforts have been devoted to perfecting and improving many details of the organization.

The Bureau of Statistics issues each month detailed reports relating to agricultural conditions throughout the United States, the data upon which these facts are based being obtained through a special field service, a corps of State statistical agents, and a large body of voluntary correspondents composed of the following classes: County correspondents, township correspondents, individual farmers, and special cotton correspondents.

The special field service is composed of seventeen traveling agents, who are especially qualified by statistical training and practical knowledge of crops, each assigned to report for a given group of States. They systematically travel over the districts assigned to them, carefully noting the development of each crop, keeping in touch with best-informed opinion, and reporting monthly and at such other times as are required.

There are forty-five State statistical agents, each located in a different State. Each of these reports for his State as a unit, and maintains a corps of correspondents entirely independent of those reporting directly to the Department at Washington. These State statistical correspondents report each month direct to the State agent on schedules furnished them. These are then tabulated and weighted according to the relative product or area of the given crop in each county represented, and summarized by the State agent, who coordinates and analyzes them in the light of knowledge of conditions derived from personal observation and other sources, and prepares his monthly and other written and telegraphic reports to the Department.

There are approximately 2,800 counties of agricultural importance in the United States. In each of these counties the Department has a principal county correspondent, who maintains an organization of several assistants. These county correspondents are selected with special reference to their qualifications, and constitute an efficient branch of the crop-reporting service. They make the county the geographical unit of their reports, and, after obtaining data each

month from their assistants and supplementing these with information obtained from their own observation and knowledge, report directly to the Department at Washington.

In the township and voting precincts of the United States in which farming operations are extensively carried on the Department has township correspondents who make the township or precinct the basis of reports, which they also send to the Bureau of Statistics each month.

Finally, at the end of the growing season a large number of individual farmers and planters report on the results of their own individual farming operations during the year, and valuable data are also secured from 30,000 mills and elevators.

With regard to cotton, all the information secured from the foregoing sources is supplemented by that furnished by special cotton correspondents, embracing a large number of persons intimately concerned in the cotton industry, and, in addition, inquiries in relation to acreage and yield per acre of cotton are addressed to the list of cotton ginners through the courtesy of the Bureau of the Census.

SCOPE OF CROP REPORTS.

Eleven monthly crop reports on the principal crops are received yearly from each of the special field agents, county correspondents, State statistical agents, and township correspondents, and one report relating to the acreage and production of general crops is received during the year from individual farmers.

Six special cotton reports are received during the growing season from the special field agents, from the county correspondents, from the State statistical agents, and from township correspondents, and the first and last of these reports are supplemented by returns from individual farmers, special correspondents, and cotton ginners.

PREPARATION OF REPORTS.

The plan of placing the final preparation of the reports in a crop-reporting board has been continued during the past year, and after two full years of trial it has been demonstrated that it is a satisfactory method. It relieves one man of the strain and responsibility and secures the benefits of consultation and the consensus of judgment of men who have been on the ground.

The crop-reporting board is composed of the Chief of the Bureau as chairman and four other members whose services are brought into requisition each crop-reporting day from among the statisticians and officials of the Bureau and the special field and State statistical agents who are called to Washington for the purpose.

The personnel of the board is changed each month. The meetings are held in the office of the Statistician, which is kept locked during its session, no one being allowed to enter or leave the room or the Bureau, telephones being disconnected.

When the board has assembled, reports and telegrams regarding speculative crops from State and field agents, which have been placed unopened in a safe in the office of the Secretary of Agriculture, are delivered by the Secretary, opened, and tabulated, and the reports, by States, from the several classes of correspondents and agents relating to all crops dealt with are brought together in convenient

parallel columns on final tabulation slips. The board is thus provided with several separate estimates covering each State and each separate crop, made independently by the respective classes of correspondents and agents of the Bureau, each reporting for a territory or geographical unit with which he is thoroughly familiar.

Abstracts of the weather condition reports in relation to the different crops, by States, are also prepared from the weekly bulletins of the Weather Bureau. With all these data before the board, each individual member computes independently, on a separate sheet or final computation slip, his own estimate of the acreage, condition, or yield of each crop, or of the number, condition, etc., of farm animals for each State separately. These results are then compared and discussed by the board under the supervision of the chairman, and the final figures for each State are decided upon. It has been interesting to note how often the reports of the different classes of correspondents and agents are very nearly identical, and how closely the figures arrived at independently by the individual members of the board agree. The estimates by States as finally determined by the board are weighted by the acreage figures for the respective States, the result for the United States being a true weighted average for each subject.

There have been 18 meetings of the crop-reporting board during the past year, in most of which the personnel has been changed each month. Six special field agents, specialists in their respective lines of statistical and crop knowledge, and eight State statistical agents have served in the different board meetings. Most of these men are widely known throughout the United States, and the practice of having them take part in the preparation of the monthly crop reports and estimates has proved highly satisfactory, and has been a great factor in establishing the confidence of the public generally throughout the country in the fairness and correctness of the Bureau's estimates.

In 1905 comprehensive and stringent orders governing the preparation of the crop reports were promulgated. They have been found to secure expedition and safety in the computations, and have satisfactorily safeguarded the reports. Such orders have been revised to date and are strictly adhered to in every detail.

METHOD OF ISSUING REPORTS.

Reports in relation to cotton, after being prepared by the crop-reporting board and personally approved by the Secretary of Agriculture, are issued on the 2d or 3d of each month during the growing season, and reports relating to the principal farm crops and live stock are prepared and made public on the 9th or 10th day of each month. In order that the information contained in these reports may be made available simultaneously throughout the United States, they are handed, at an announced hour on report days, to all applicants and to the telegraph companies. These companies have reserved their lines at the designated time, and forward immediately the figures of most interest. A mimeograph or multigraph statement, also containing such estimates of condition or actual production, together with the corresponding estimates of former years for comparative purposes, is prepared and sent immediately to a mailing list of exchanges, newspaper publications, and individuals. The same afternoon printed cards containing the essential facts concerning the most important crops of the report are mailed to the 77,000

post-offices throughout the United States for public display, thus placing the most valuable information within the farmers' immediate reach.

STATE STATISTICAL AGENTS.

Particular efforts have been made during the year to improve and perfect this important class of correspondents, and special care has been exercised in the selection and appointment of new agents where vacancies have occurred from death and resignations. Only men possessing proper qualifications and fitness have been selected, and then only after careful investigation by representatives of the Department. Many of the State agents have been visited and their offices inspected by officials of the Bureau during the year, and it is gratifying to note that their methods of securing data and compiling their reports have been brought to a scientific and uniform basis.

The appropriations of this Bureau were somewhat increased last year, and one of the principal reasons was to enable the State statistical agents to travel within and throughout their respective States for the purpose of making personal investigations of crop conditions, and of meeting their correspondents or aids, and enlisting the services of new ones. About $5,000 was allotted for this purpose during the year, and the State agents were directed to travel in the spring at the time inquiries are made as to the acreage of the principal crops, and also in the fall or near the time of harvest, when inquiries are made as to the yield and production. Excellent reports have been received from the different agents as to the great assistance and advantage of this travel, and it is felt that such benefits have been reflected in improved and more accurate reports from such agents.

SPECIAL FIELD AGENTS.

By means of a slight increase in the appropriation of this Bureau the corps of field and traveling agents was increased by the appointment of two additional men, and the territories of several of the agents have been redistributed and reassigned, so that the entire country is now better covered and represented by this class of reporters. The number of agents has been increased to 17; the principal cotton-producing States are now covered by 6 agents, while 8 others are assigned to the remaining territory of the United States, including the principal wheat and corn producing States, and 3 others are principally engaged in collecting statistics throughout the United States in regard to such crops as tobacco and rice.

INTERNATIONAL TRADE AND PRODUCTION STATISTICS.

Renewed efforts were made during the year to enlarge the statistical information of the Yearbook concerning international trade in agricultural products and concerning the agricultural production of all of the countries of the world for which information is obtainable. International trade tables are now compiled and published for corn, wheat, wheat flour, and for wheat and wheat flour combined in terms of bushels of wheat; for cotton, unmanufactured tobacco, hops, rice, sugar, tea, coffee, oil cake and oil-cake meal; for rosin, spirits of turpentine, india rubber, wood pulp, wool, hides and skins, butter,

cheese, live meat animals, and packing-house products. There are twenty-two commodities for which tables of the international trade of most of the countries of the world are prepared.

The statement of the agricultural production of all countries ascertainable has been enlarged by the inclusion of several products heretofore omitted, and the full list of these products now embraces fifteen products, viz, corn, wheat, oats, barley, rye, potatoes, cotton, tobacco, hops, flaxseed, rice, sugar, cocoa, silk, and wool.

The compilation of the number of live stock for all countries for which the facts are known or estimated has been improved and expresses the best information concerning the number of cattle, dairy cows, horses, mules, swine, asses, sheep, domesticated buffaloes, camels, goats, and reindeer.

MEAT SUPPLY AND SURPLUS.

An investigation in relation to the meat supply and surplus of the United States was made, to determine, among other things, the meat production of this country and the per capita consumption, the importance of the meat industry as indicated by the capital directly concerned, the disposal of the national surplus of meat among importing countries during a long period of years, the stock of meat animals at census dates beginning with 1840, and the declining per capita consumption of meat.

In this investigation attention was given to meat consumption by workingmen's families, as determined by the Bureau of Labor; to the prices of meat and the consumer's cost of the meat consumed annually. Much information was presented concerning the quantity of meat consumed in foreign countries. A specially full statement was prepared for Germany, made possible by the meat-inspection law of 1904.

This investigation made it possible to state the number of hides and skins produced in this country in 1900 and also the number of beef hides consumed in that year.

An investigation was also made of the restrictions against the importation of meat from the United States into principal European countries, which resulted in a summary of the prohibitions of principal European countries affecting pork, cattle, and beef, and of the restrictive measures which make the exportation of meat and meat products from the United States to these countries difficult, if not impossible, and of the technical procedures in exporting to those countries.

THE LIBRARY.

The growth of the Library during the past year has been greater than that of previous years. It now contains 95,660 books and pamphlets relating to agriculture and kindred sciences and the subjects connected with the various activities of the Department. It is as far as is known the largest collection of agricultural literature not only in this country but in any country, and is indispensable in the work of the Department. The greater growth of the past year has been largely due to the increased number of publications received in exchange for the publications of the Department, especially from foreign countries. These exchanges form a very important part of the Library, without which the work of the Department would be seriously hampered.

During the past year 1,815 periodicals, exclusive of annual reports of societies and institutions, were received by the Library, and of this number nearly two-thirds were received by gift and exchange. In addition all the important current scientific works bearing upon the work of the Department are purchased, in so far as the funds of the Library permit. The catalogue of the Library has grown till it now contains about 185,000 cards, forming a valuable key to agricultural and scientific literature.

With the cooperation of the Library of Congress, the Library of the Department has continued the printed catalogue cards for accessions to the Library, and the printed catalogue cards for Department publications, which have proved useful to many libraries. Although the main use of the Library is in connection with the work of the Department, it is in addition the National library of agriculture, and the aim is to extend its usefulness as widely as possible, first by the completeness of its collection, second by the printing of catalogue and index cards and the publishing of special subject lists, and third by the loan of its books to scientific workers connected with the various State colleges and experiment stations. During the past year books have been sent to twenty-nine different States, from Maine on the east to California on the west. Each year the extent and importance of the Library's collections is becoming better known, and the usefulness of the Library, not only to the Department but to agricultural scientists throughout the country, is shown to be steadily increasing.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The work of the Office of Experiment Stations in its relations with the agricultural experiment stations throughout the United States has been largely extended during the past year on account of its new duties connected with the administration of the act of Congress of March 16, 1906 (Adams Act). Never before has there been such a widespread and thorough discussion of the nature, requirements, and limitations of the different classes of work which our stations have undertaken for the benefit of agriculture. As a result, the organization of the stations has been greatly strengthened and a large amount of fundamental research has been inaugurated, while at the same time broader efforts have been made to reach and aid the masses of the farmers, both by publications and by practical demonstrations of improved methods. The great need and opportunity for fundamental investigations in agriculture have been brought out very definitely, and the wisdom of Congress in providing liberally for the endowment of such research by enactment of legislation of a permanent character has been abundantly shown. It is also more apparent that the more directly practical experiments and demonstrations which have been so popular in the past appeal strongly to local public sentiment and can be readily supported by State appropriations. The legislatures which have met during the past year have shown much liberality toward the stations, and it is evident that the increase of National funds for these institutions will stimulate rather than retard State aid in their behalf.

The plans for the Adams fund work have been worked out with unusual care and deliberation, and, taken as a whole, they embody

a large amount of investigation in the true sense, which will place agricultural science and research upon a higher plane. Considering the condition under which the first year's work had to be planned, the difficulty in securing men, the lack of uniform standards, and the diversity of views regarding what constitutes "original research" in agriculture, the programme must be regarded as very satisfactory. Not only has the amount of investigation greatly increased, but the outlining of the various undertakings in advance has also had the effect of systematizing the station work more thoroughly than ever before, and ultimately this should reflect favorably upon the activities of the station in other lines. If the system inaugurated for the Adams fund projects shall become more generally applied to the station work as a whole, it will be an important result of the first year's operations under the new act.

Together with the strengthening of the organization of the stations, there has been a clearer differentiation between their legitimate work and that of the colleges, farmers' institutes, and other educational agencies. In a considerable number of instances special officers have been provided whose main duties are in connection with the investigations under the Adams Act, and a number of stations are looking toward the provision of a staff for the station work, practically distinct from the teaching staff of the college. This better provision for the station work will increase its efficiency, prevent serious interruptions, and make the station more strictly an institution for experimentation and research in agriculture.

We must look to the agricultural colleges to train more men for this important work and to inspire them with the proper spirit and point of view. This will necessitate a further differentiation of courses of study to meet the needs of agricultural scientists as contrasted with those of practical farmers. Not only must the standard of undergraduate courses be raised, but special graduate courses of the most thorough character must be provided. Otherwise the development of the experiment stations will be delayed and the agricultural interests of the country will suffer.

THE AGRICULTURAL COLLEGES AND SCHOOLS.

Each year now witnesses a great extension of the movement for the diffusion of agricultural education among the masses of our rural population. The national character of this movement has during the past year been conclusively attested by the passage by Congress of the Nelson amendment to the appropriation act for this Department for the fiscal year 1908, in which provision has been made both for extending the ordinary agricultural courses in our colleges and for the training of teachers of agriculture for the elementary schools. The celebration at Lansing, Mich., of the fiftieth anniversary of the beginning of agricultural education in this country marks an important step in the progress of the education of "the man who works with his hands." There have also been numerous local examples of the growth of this movement, notably the establishment of eleven agricultural high schools in Georgia, of single agricultural high schools in a number of States, and the enactment of permissive or mandatory legislation concerning agricultural high schools and the teaching of agriculture in the common schools in Texas, Michigan, and other States.

With every forward step in this movement greater demands for assistance are made upon this Department, and it becomes more clearly evident that in keeping with American custom in other lines some National agency is desirable to focus the experience gained in our several States and in other countries and, without exercising any control, but by diffusing information and stimulating local enterprise, to aid in systematizing and developing an efficient system of agricultural education throughout the length and breadth of our land. Such work in agricultural education as this Department, through its Office of Experiment Stations, has attempted to do has been along these lines. During the past year that Office, under authority granted by Congress, has responded to demands for services extending over the entire range of agricultural education from graduate instruction to the most elementary forms of extension work. Representatives of that Office have visited the agricultural colleges, prepared upon request courses in agriculture for agricultural high schools in Georgia and Maryland, addressed important meetings in the interests of agricultural education, and assisted at county institutes in preparing teachers of elementary agriculture.

Cooperation with the Association of American Agricultural Colleges and Experiment Stations in matters relating to agricultural education has been continued. As chairman of the standing committee on instruction in agriculture, the Director of that Office has aided in preparing exercises and courses of instruction for elementary and secondary public schools. He has also consented to act as dean of the Graduate School of Agriculture during its third session, in 1908, at Cornell University, and begun to organize the faculty and work of that school.

As regards the subject-matter which is needed to form suitable courses of instruction in agriculture and to aid the teachers in elementary and secondary schools in adapting such courses to the requirements of different regions and different classes of students, the Office of Experiment Stations is in a position to render a service which it would be difficult for any other agency to perform. That Office regularly gathers and reviews practically all the literature on agricultural subjects issued by public and private institutions throughout the world. Out of the mass of material it now selects and abstracts for publication in the Experiment Station Record a few of the most important articles, but it could at comparatively little additional expense select and put in pedagogical form much more information that would be of very great service to teachers and students of agriculture in every State and Territory. If elementary and secondary instruction in agriculture is to be established in an effective manner and kept thoroughly alive and up to date our schools must regularly receive and utilize the new knowledge which the institutions for agricultural research and advancement are accumulating.

FARMERS' INSTITUTES.

The reports received from the State directors of farmers' institutes show that there has been a large increase in attendance during the past year. The total attendance was more than 1,500,000, exceeding by several hundred thousand that of the previous year. Special subject institutes are rapidly growing in favor. Most of the States have held special dairy, fruit-growing, corn-judging, and cattle-judging

institutes. These meetings were devoted to a discussion of some one of these topics, were continued from two days to a week, and were conducted by expert instructors who gave practical demonstrations in connection with their lectures. Seven States held special institutes for women, and contests in growing corn, wheat, flowers, fruits, and vegetables have been instituted in a number of States to interest the farmers' children in the institute movement.

The movement for supplementing the farmers' institutes by the holding of short courses of instruction in special subjects at the agricultural colleges and in different agricultural districts is growing rapidly and already attempts are being made to organize and develop these movable schools. To aid this movement by showing definitely the character of courses of instruction which might be given on this plan this Office has arranged with agricultural experts for the preparation of a number of such courses.

In cooperation with the standing committee on extension work of the Association of American Agricultural Colleges and Experiment Stations, this Office has made an extended study of the agencies outside of the farmers' institutes which are engaged in diffusing agricultural education among our rural people. The results of this investigation have been embodied in reports of the committee of the association and have been published as circulars of this Office. It is evident that a broad field of usefulness is opening before the agricultural colleges in extending their work of instruction among the masses of agricultural people who can not attend the courses given at these colleges. They are now beginning to organize and develop an adequate system of extension work in agriculture. To aid them in this work they are calling on this Office for services which are entirely beyond our power to perform with our present force. Since the National Government is so fully committed to the policy of giving the States assistance in diffusing scientific and practical information on agricultural subjects among our rural people, it would seem a wise thing to provide the comparatively small fund needed to make this Office an efficient clearing-house for this forward movement in agricultural education.

Foreign countries for many years have appreciated the importance of orally instructing rural people in agriculture. In addition to agricultural teaching in their universities, colleges, normal schools, academies, and secondary and common schools, numerous special classes of adults are organized in the country districts for instruction by itinerant methods. Professors of agriculture under Government direction are sent out to give instruction in the normal and rural schools, and to organize farmers' societies for the promotion of agriculture. Numerous agricultural high schools have been established, particularly in Denmark and Sweden, and are attended by large numbers of rural people of mature years. Demonstration fields showing the effects of various manures, methods of culture, and varieties of seeds upon crop production are found everywhere. More than 3,000 of these demonstration fields and farms are in operation in France alone.

INSULAR STATIONS.

The experiment stations in Alaska, Hawaii, and Porto Rico have made pronounced progress during the year, and their efforts in the

development and diversification of agriculture are beginning to be appreciated in their several communities.

The Alaska stations are devoting their efforts to live stock, horticultural crops, and cereal growing. In continuation of the policy of developing a station herd, there are now over 40 head of Galloway cattle divided between the Kenai Station and the newly established animal breeding station on Kodiak Island. The principal experiments at the central station at Sitka are along horticultural lines and plant breeding. As a result of the plant-breeding experiments, hybrids of strawberries, raspberries, and other small fruits have been produced and are under observation. These are the results of crossing some of the native hardy species with improved varieties. Cereal investigations and the production of forage are being given especial attention at both the Rampart and Copper Center stations. Winter wheat and winter rye and spring-sown wheat, rye, barley, and oats matured their crops at Rampart during the past season, as they have done every year since the establishment of the station in 1900. Some of the varieties of cereals ripened at Copper Center, several hundred miles farther south, but nearer the mountains. At both stations the production of grain hay has been shown possible. Work was begun this year at the station in the Tanana Valley near Fairbanks, and a considerable area was cleared and prepared for cultivation. The special agent in charge anticipates important results from the establishment of this station, as it is nearly in the center of a large area that is apparently capable of considerable agricultural development.

The Hawaii Station has continued its investigations along the lines of diversified agriculture, devoting especial attention to investigations on tobacco, rubber, rice, and honey and fruit shipments. That cigar tobacco of good type can be successfully grown in Hawaii has been proved. The rice investigations have already shown the possibility of greatly increasing the yield of that crop, and at the same time the expense of production may be reduced by the adoption of more modern methods of cultivating and handling the crop. The planting, cultivation, and tapping of rubber trees and the coagulation of the latex are being investigated, and promising results have already been obtained. The experiments in fruit shipment have been continued, and it has been shown possible to land Hawaiian pineapples and avocados in Chicago in excellent condition. These investigations are of great economic importance to Hawaii, as they show the possibility of supplying the markets of the western portion of the United States with tropical fruits. Studies have been made that lead to a better understanding of Hawaiian honeys, which will possibly result in an enlarged market for that important product.

The Porto Rico Station is giving its attention to problems of soil management, crop rotation, methods of cultivation and improvement, horticultural problems in connection with citrus and other fruits, pineapples, etc. Following the successful efforts of the station in shipping pineapples to New York and other markets, large quantities of the more desirable varieties are now being exported. The station is carrying on cooperative work with planters along a number of lines, and the results of these efforts are beginning to be seen in the adoption of improved methods of crop production. The coffee experiments have been especially valuable, and if the economic conditions relating to the marketing of the crop should be changed,

the suggestions given regarding planting, fertilizing, cultivation, pruning, and shading will be widely adopted. The collections of economic plants are being extended, and the horticulturist reports the successful introduction of a considerable number of varieties of European and American grapes. The entomologist has devoted much of his time during the past year to combating the insects occurring on citrus and other trees, and reports the discovery of a very active parasite on the eggs of the tobacco horn worm. It is believed that this parasite can be successfully utilized.

The stations are all developing quite rapidly, and for their proper support I recommend for them appropriations equal to the amounts given each of the State stations under the Hatch and Adams acts.

NUTRITION INVESTIGATIONS.

The nutrition investigations, carried on under the auspices of the Office of Experiment Stations, were undertaken primarily to learn the nutritive and economic value of agricultural products of animal and vegetable origin used as food for man. In carrying on the work during the past year it has been the policy, as in the past, to cooperate with agricultural experiment stations, agricultural colleges, universities, and other institutions in different States and Territories, and to establish centers of investigation wherever an institution or region offered special facilities. Thus, cereals and cereal products have been studied at the Maine and Minnesota agricultural experiment stations, the nutritive value of fruit and nuts at the California Experiment Station, and the nutritive value of cheese at Middletown, Conn., and the Minnesota Experiment Station. In this way the Department funds have been materially supplemented by the contributions of the cooperating institutions and the results obtained have been large in proportion to the outlay. New experiments have been undertaken whenever the completion of any line of work has rendered this possible, and the enterprise as a whole has been systematized and grouped as a series of projects in accordance with the general plan for the work of the Department of Agriculture.

The Washington office has been responsible for the plans for the work as a whole, for the editing of the results, and the distribution of information, as well as for some special investigations.

The experiments at the California Agricultural Experiment Station have demonstrated the comparatively thorough digestion of fruits and nuts of different sorts and the nutritive value of these important crops and their value as foods rather than food accessories.

In accordance with the action taken by Congress at its last session, the respiration calorimeter and accessory apparatus have been brought from Middletown, Conn., to Washington and stored.

The experiments on the digestibility and nutritive value of different kinds of cheese, carried on at the Minnesota Agricultural Experiment Station, supplement earlier work of this character at Middletown, Conn., confirm the results obtained, and materially extend the conclusions reached. As shown by the large number of digestion experiments with healthy men, cheese, both the ordinary American Cheddar and other sorts studied, is on an average very thoroughly digested without physiological disturbance and compares favorably with other staple foods as a source of nutrients and energy. In other words, cheese is to be regarded as a food for use in quantity when desirable or convenient rather than as a condiment for occasional use.

At the University of Illinois the experiments on the effects of different methods of cooking on the nutritive value and digestibility of meat of different kinds and cuts have been continued. The conclusion reached is that meats of all kinds are to be ranked among the very digestible foods. No marked difference was observed in either the ease or thoroughness of digestion of different kinds or cuts.

Experiments on domestic canning and preserving of vegetables have been continued at Wellesley College, Massachusetts, and as a result of this inquiry and earlier work satisfactory methods have been devised and await publication.

The studies at the University of Chicago of the changes brought about in cooking fruits and the effects of different methods on the yield and quality of the cooked product have furnished valuable data applicable in domestic jelly and jam making.

At the Maine Agricultural Experiment Station investigations regarding the digestibility and nutritive value of different sorts of corn meal prepared for the table in a variety of ways have been continued, and the work as a whole has demonstrated the high nutritive value of this important cereal crop and shown the reasonableness of its use in quantity as an integral part of the diet.

The studies of the effects of different methods of grinding on culinary quality, which have been made at Teachers' College, Columbia University, New York, have made it plain that by suitable methods of manipulation in cooking it is possible to obtain uniform results with both old water-ground and new-process meal.

At Columbia University, New York, studies on the ash content of foods have been continued, and a bulletin has been prepared setting forth the results obtained with calcium, magnesium, and phosphorus.

Cooperating with Drexel Institute, Philadelphia, dietary studies have been made in a home for aged women and an orphan asylum. It is proposed to incorporate the results with those of similar work carried on in Baltimore institutions as a contribution to the question of dietetics in relation to institution management. The results also supply valuable information regarding food requirements in early youth and old age as compared with the period of full vigor.

Studies of the pedagogics of nutrition have been continued, especially in cooperation with Teachers' College, Columbia University, New York, and a large amount of data has been collected and systematized regarding the higher courses in domestic science which are given in American agricultural colleges, universities, normal schools, and kindred institutions. The total number at present on record which give such courses is 150, of which one-third are institutions receiving Government aid. The courses vary decidedly in scope and extent, but the importance which the subject of home economics is assuming in modern education is very apparent from the data available. The nutritive value of food is one of the important subjects included in such courses, and in these institutions, as well as in medical colleges, Department nutrition publications are very commonly used as text-books, owing to the fact that other satisfactory reference works on the subject have not hitherto been available. These publications are also largely used in the numerous secondary and elementary schools where courses on foods and cooking are given.

The problems concerned with the rational and economical utilization of agricultural products as human food are so intimately and

vitally related to those connected with the production of the food stuffs on the farm that the nutrition investigations may well be a part of the work of this Department. The experimental methods which have been elaborated and the lines of work which have been followed in the nutrition investigations are well fitted to supply the information which is needed in order to utilize in a satisfactory way the available food supply in the proper and economical feeding of families and groups. In view of the demonstrated usefulness of this work and the large demand for information along these lines, especially for use in connection with our public and private schools, where the scope of instruction relating directly to home life of our people is being steadily enlarged, I earnestly recommend that provision be made for the continuance of these investigations. A place has been provided in the new Department building for the respiration calorimeter, and it will be possible there to continue the fundamental researches which are required to put our knowledge of the utilization of food in the body on a thoroughly scientific basis.

IRRIGATION AND DRAINAGE INVESTIGATIONS.

Recently the chief of irrigation and drainage investigations has accepted an invitation of the Australian government to take the supervision of the work in irrigation which that government is about to undertake for the benefit of agriculture in that country, and has withdrawn from the service of this Department. This has opened the way for a reorganization of our irrigation and drainage investigations, which seemed advisable in view of the present extent of this enterprise and a quite distinct differentiation of the irrigation work from that in drainage, both as regards the character of the projects and the regions in which they are carried on.

IRRIGATION INVESTIGATIONS.

The work of this Department in irrigation divides itself into three geographical divisions, each with its own peculiar problems: The older irrigated sections, where the irrigated area has been extended to the limit of the water supply and where economy in water is the most pressing necessity; the section just brought under ditch, where water is plentiful for the present and where the prevention of waste of labor and money by the settler in bringing the land under cultivation is a condition of success; and the sections where farming has been carried on without irrigation but where droughts occur with sufficient frequency to make success doubtful, or where raising prices or soil exhaustion makes more intensive farming necessary.

The work in the older sections consists of experiments to determine the losses of water under ordinary practice and how these losses may be prevented. Water is lost by seepage from ditches, by evaporation from water surfaces and from the wet soil, by percolation beyond the reach of plants, and by waste which may seem necessary to properly wet the soil. We are making experiments to find cheap and effective ditch linings to prevent seepage losses, which in many instances are more than 50 per cent of the water entering the ditches. We have made experiments to determine the losses by evaporation and the effectiveness of different methods of applying water and cultivating the soil after irrigation in checking these losses, the results showing that half the water lost in this way can be saved. We have made

observations to determine how far the water applied by different methods to different types of soil penetrates into the soil for the purpose of adapting methods of applying water to soil conditions in such a way that proper moisture conditions may be maintained without loss by percolation beyond the reach of plant roots or by surface run-off.

During the past five years construction of irrigation works has outrun settlement. During that time the Government has expended $40,000,000 in irrigation construction, and private parties at least an equal amount. A canvass recently made indicated that as a result of this activity there would be at least 5,000,000 acres of unreclaimed land provided with a water supply ready for settlement in 1908. The cost of preparing this land for irrigation and providing the equipment for successful farming will be fully as great as the cost of building the canals to bring water to it, so that when the canals are built the work of reclamation is but half done. The safety of this whole investment in irrigation works and in the preparation of land for use, and, what is much more important, the safety of thousands of future homes, depend upon the use of proper methods both in the preparation of the land and in the subsequent use of water. The cost of the irrigation works, whether they are built by the Government or by private parties, must be repaid by the settlers, and their success or failure means success or failure for the projects. These settlers must come largely from sections where irrigation is not practiced, and will be unfamiliar with the use of water. Mistakes in the preparation of the land and in the adoption of methods of applying water are costly not only in the time and labor lost, but also in decreasing crop returns, and, in addition, they come at a critical time, when payments for land, water, implements, stock, and food are all pressing. It is our endeavor to aid the settlers at this crucial time by telling them how to do the work with the least expenditure of time and money, and in such a way as to get the best results. This is done through bulletins, the giving of practical directions through personal advice by the more experienced of our field men, and through demonstration farms established under cooperative agreements with local parties, with State experiment stations, and with the Reclamation Service of the Department of the Interior.

In the semiarid region the four irrigation extension farms established last year have been maintained. Each is situated where no large supply of water is available and where most of the land must be farmed without irrigation. These stations are to determine and demonstrate the possibilities and cost of irrigation with the small water supplies which can be made available in these regions in the hope that the irrigation of a small area in connection with the use of drought-resistant crops and intensive cultivation on a much larger area may enable settlers to successfully maintain homes on the high plains, which otherwise must be devoted to grazing only.

The rush of settlement in this region in the past few years is in many respects similar to previous waves which have swept over it, and many have feared a repetition of the former disasters which wrecked so many homes and lives. It is to guard against this that we are making every effort to provide the settler with a means of pulling himself through the years of drought, while looking to the wet years for his profit.

It is our belief that irrigation may profitably be extended into other sections where it has not been considered necessary. We are this year carrying on experiments to determine this in the Willamette Valley in Oregon and in the Sacramento Valley in California, while we have maintained an experiment as far east as Iowa. Previous experiments have shown that irrigation is profitable as a crop insurance, even in the extreme East, and a knowledge of its possibilities and methods will lead to its extension in the future, until it will be practiced to some extent throughout the United States.

In many places where irrigation is now practiced water is secured by pumping, and the extension of irrigation into many sections will depend upon the ability to secure water in this way cheaply. The use of power in irrigation and drainage is made a part of our work, and we have made many tests of pumps, engines, and windmills, in order to be able to answer the inquiries received from those wishing to pump water for irrigation. These tests show efficiencies of the pumping machinery varying from 5 to 80 per cent, thus demonstrating the great need which our farmers have of accurate information on which to base their purchases of machinery suited to their purposes.

DRAINAGE INVESTIGATIONS.

This line of work has developed and expanded more rapidly during the last year than ever before. The demands for information, assistance, and advice in relation to the drainage of agricultural lands in all sections of the country have been so numerous that it has been beyond the physical possibilities of the available office and field force to comply with all the requests, and it has hence been necessary to postpone compliance with many meritorious applications for assistance.

The operations of the drainage investigations have included work during the past year in about two-thirds of the States of the Union. The survey of the Kankakee Valley project in Indiana was completed and a report embodying the results of three years' investigation was prepared and transmitted to the local authorities. Nearly half a million acres in this valley were once a marshy plain. During the last twenty years numerous small projects for the improvement of the drainage of separate portions of the upper end of the valley and areas along its outer margins, by means of straightening, cleaning, and deepening parts of the channel of the river and its tributaries, have been successfully completed. In this way large areas have been rendered available for profitable agriculture. At the time this Office took up the work local jealousies and differences of opinion had reached such a state that it seemed impossible for the various interests to reach an agreement which would lead to the relief and improvement of the large and important areas embraced in the main lower part of the valley.

As a result of the careful surveys and studies by the engineers of this Office a comprehensive plan was prepared in this Office for increasing the carrying capacity of the lower portion of the river channel by shortening its length from 72 miles to 42 miles. This is accomplished by cutting off 84 bends of the present stream by cuts varying from 150 to 5,500 feet in length. The excavation of this channel will require the removal of nearly 10,000,000 cubic yards of earth and will cost approximately $1,000,000. This improvement

involves six counties in Indiana and one in Illinois. Probably 500,000 acres of land will be directly benefited. The value of these improvements can scarcely be estimated, although similar land in Indiana has risen in value from $5 to $100 per acre after drainage.

During the winter of 1906–7 a preliminary survey was made of a part of the Everglades of Florida, an area of swamp land covering some 5,000 square miles. A line of levels was run from Fort Myers, on the Gulf coast, across the glades south of Lake Okeechobee to the Atlantic coast, connecting on the way with the surface of Lake Okeechobee. This survey was made in the face of great physical difficulties, it being necessary for the men engaged to carry all their supplies for a distance approximating nearly 50 miles through soft muck, with the aid of canoes for only part of the way. This was the first time that a survey had ever been carried across the region, although there had been numerous previous attempts. The results so far attained encourage the hope that the further investigations which will be made will prove the practicability of reclaiming profitably for agricultural use a large area of this land, which is now too wet to be successfully cultivated and is hence practically worthless.

Surveys of the lowland subject to injury by overflow lying along the Red River of the North in North Dakota were concluded in Pembina County, thus completing the project previously begun and embracing also Cass, Traill, Grand Forks, and Walsh counties. The total area surveyed was about 3,000 square miles. Plans and estimates were prepared for drains for this entire area. The work was carried out under a cooperative agreement among the counties interested, the State engineer's office of North Dakota, and this Office. The report has been printed and submitted to the local authorities.

The field work was completed and plans prepared and submitted to the people for improving the Neosho River in southeastern Kansas. The watershed drained by this stream embraced 5,090 square miles and the plans provide for the protection of 161,000 acres of overflowed land, at an average cost of $9 per acre. It is generally conceded that the loss and damage from the overflow in 1904 were more than the estimated cost of protecting these lands. The report discusses fully the engineering problems involved, and the accompanying maps give the elevation of the overflowed lands and the profile and cross section of the stream and the details of the proposed improvement.

Much attention has been given to the possibilities of drainage in the Delta region of the lower Mississippi Valley. A very active interest has recently developed in drainage in this region. In Arkansas, Louisiana, Mississippi, and Missouri there is a constantly growing agitation of the matter. The completeness of the levee system is now rendering safe the expenditure of large sums for the improvement of the low flat lands formerly subject to overflow by the Mississippi floods. This Office has made preliminary examinations of large portions of this region and has so far as means were available assisted in the organization and plans for actual drainage construction for definite limited areas.

The problem of the reclamation of the swamp tide lands along the Atlantic coast has been frequently urged upon this Office, and has received special attention during the last year. Special examinations have been made in various localities, advice has been given, plans

have been prepared, and publications have been issued devoted to this phase of drainage. Experiments to determine the best methods for the removal of excess seepage water and accumulated alkali from the irrigated regions in the West have been continued.

Gratifying reports have come to the Department from localities where the drainage plans, prepared in previous years, have been put into execution, showing the great benefits which have accrued to farmers who have carried out the advice given by this Office. During the last fiscal year plans were prepared for the drainage of about 2,000,000 acres.

OFFICE OF PUBLIC ROADS.

It is the province of the Office of Public Roads to investigate the various conditions affecting the public roads and to ascertain and make known the remedies for the evils in existing systems and methods of road construction and administration. During the past year the work of the Office was divided into twenty-two projects, dealing with practically every subject of interest in connection with wagon roads. This represents a greater number of projects than have been undertaken in any single previous year.

ROAD MILEAGE, REVENUES, AND EXPENDITURES.

The close of the year marked the completion of the first census ever made to determine the road mileage, revenues, and expenditures in this country. This investigation was begun early in 1905. Information covering the calendar year 1904 was obtained from carefully selected correspondents in every county in the United States, from State highway departments, State geologists, city and county officials, employees of the Office of Public Roads on field duty, commercial and agricultural associations, and newspapers—in fact, every possible source of information was used. In some of the States reports were made by townships. While these reports are in some cases incomplete, the greatest care has been taken in their verification, and the results as a whole are reasonably accurate. The bulletin recently issued on this subject shows the enormous total of nearly 2,152,000 miles of public road; that 7.14 per cent of this mileage has been improved, and that the total expenditure for 1904 was approximately $80,000,000. Considering the fact that our improved roads have been in process of construction for a number of years, it becomes evident that the results which we are obtaining are totally inadequate to the amount of money expended, and that the mileage is so great that we must of necessity classify our roads according to their importance, bearing in mind the fact that by far the largest proportion of our earth roads must be maintained as such for many years to come.

METHODS OF ROAD CONSTRUCTION AND MAINTENANCE.

The construction of object-lesson roads in cooperation with local authorities was continued during the year along the same lines as in previous years, excepting that greater attention was given to the building of earth, sand-clay, and gravel roads. In every case the local authorities furnished common labor, materials, teams, and fuel. The engineers of the Office of Public Roads were instructed to ascertain in their preliminary work as accurately as possible the character of construction best suited to the locality, and under no circumstances

to recommend the building of a road which, though excellent in itself, might represent a form of construction ill suited to the locality or too costly to be continued. Sixteen roads were completed during the year, representing a total of 200,711 square yards, which is far greater than the amount completed in any preceding year. The work of construction was supplemented when practicable by informal lectures, explaining the methods used in building the object-lesson roads.

The endeavor has been made to reduce the cost of construction to the lowest point consistent with efficiency, recognizing the fact that the cost of building improved roads is the chief obstacle in the way of their general adoption. The cost of macadam in a road built at Williamsburg, Va., was only 36.3 cents per square yard, or at the rate of $2,556.22 per mile, exclusive of engineering assistance and machinery furnished by the Office.

Work on the object-lesson roads was carried on during the year in Alabama, Arkansas, the District of Columbia, Kansas, Kentucky, Louisiana, Maryland, Montana, Nebraska, North Carolina, Oregon, Tennessee, Virginia, and Washington.

A bulletin on the construction of macadam roads, based upon the best practice in the States which have made the greatest progress in macadam road building, was issued during the year. Earlier studies of sand-clay and burnt-clay construction showed these to be valuable methods in those sections of country where hard materials are lacking.

The mixing of sand and clay has long been recognized as an effective method of road construction. The burning of clay for railroad ballast was begun some years ago, but its adaptability to road building has only been made known by this Office in recent years.

Experiments in the use of burnt clay as a road material at various points in Mississippi give most favorable indications of success, and it seems quite probable that a long step forward has been taken in solving the road problem in the Mississippi Delta.

The maintenance of earth roads has received special consideration, and an expert in the construction and use of the split-log drag has been employed to aid in the general introduction of this simple and effective means for bettering earth roads.

Many failures in road building are due not so much to a general disregard of standard methods of construction as to serious mistakes in some particular feature of the work. For instance, the cost of quarrying the stone may be excessive through ignorance of the best practice; the road may prove unsatisfactory because of a poor location or on account of the use of inferior material. In all such cases expert examination and advice will go far toward enabling the local road officials to remove the difficulty. During the past year about forty such assignments were made from the Office of Public Roads. In one county in Alabama a strong movement was on foot to issue bonds for a large amount for the purpose of building macadam roads. An engineer detailed from this Office upon request ascertained that the conditions were satisfactory for building sand-clay roads and very poor for building macadam roads, the material for the latter being inaccessible except at great cost. He advised the building of sand-clay roads. His advice was followed, and to-day that county has 118 miles of road built at a cost of $22,000 which meet the requirements of traffic practically as well as macadam roads would do.

LECTURES.

The trend of public opinion with reference to our public roads is indicated by the requests which have been received during the past year for the detail of men to lecture on road improvement. In former years the demand for lectures on road improvement came largely from road organizations, but during the past year requests have been received from agricultural, industrial, scientific, and commercial organizations which are taking up the subject. These requests have been complied with as fully as possible, and the most careful effort has been made in all cases to confine the lectures to practical topics, and to give information and advice based upon actual experience and careful study of the subject. In all, about 150 lectures were given during the year.

INSTRUCTION IN HIGHWAY ENGINEERING.

The plan of appointing graduates of engineering schools to the position of civil engineer student in the Office of Public Roads has been continued during the past year with marked success. The necessity for competent highway engineers to direct the work of road building along proper lines has become increasingly apparent in recent years. The remarkable success of the French road system is largely due to the fact that the Government maintains a school of roads and bridges, from the graduates of which is recruited a thoroughly efficient corps of highway engineers. The course of training given in the Office of Public Roads of this Department covers a period of only one year, but instruction even to this extent is beneficial to the student, the public service, and the city, county, or State which eventually employs the young man receiving such instruction. Six students were appointed during the past fiscal year, making a total of fifteen since the inauguration of this project.

A plan for introducing more thorough and practical courses in highway engineering in the various schools and colleges was put in operation during the past year, whereby engineers of the Office of Public Roads are detailed for a series of lectures on highway engineering at some time during the regular school year.

INVESTIGATION OF THE PROPERTIES OF ROAD MATERIALS.

The total number of road-material samples received for testing during the year was 405, as compared with 384 for the preceding year. The greater number of samples were received from State geologists and State highway commissions, a gratifying fact, since it insures the best disposition of the data obtained in the Office of Public Roads. The State geologists of Maryland, Massachusetts, Montana, and New Jersey, and the highway commissions of Connecticut, Massachusetts, Minnesota, Ohio, Pennsylvania, Rhode Island, and Virginia cooperated in this manner.

During the year progress was made in the design of special equipment for conducting road-material tests. The most important addition to such equipment was a new impact machine for testing the toughness of road-building rock. In July, 1906, specifications developed in the Office of Public Roads for determining the toughness of rock for road building were submitted to the American Society for Testing Materials and adopted by that society.

As a result of the petrographic examination of rocks used in road making, a classification of such rocks has been made and facts of importance gained bearing on the relation of the physical properties of rocks to their mineral composition and structure.

SPECIAL INVESTIGATIONS.

I desire to call special attention to the investigation relative to the corrosion of iron. This investigation, begun in connection with the subject of metal culverts and fence wire, has produced results of far-reaching importance. It has demonstrated that the generally accepted theory regarding the oxidation of iron is incorrect, and that by treating the surface of iron with a strong oxidizing agent the rusting can be inhibited so long as the oxidizing agent is present.

Experiments conducted for several years relative to the decomposition of rock powders have also led to valuable results. A fact of great importance in road construction established by this investigation is that a better bonded surface for roads can be secured by mixing rocks such as limestone with the more siliceous crystalline rocks. This work has led to a more extended investigation relating to the extraction of potash from feldspathic rocks. Reference has been made to this work in previous reports, and it has been described in several bulletins. It seems probable that these studies will develop a method commercially practicable for extracting potash from feldspathic rocks. If this is done our dependence upon foreign sources of supply for potash will be decreased, at least to a certain extent.

COOPERATION WITH DEPARTMENTS AND BUREAUS.

During the past year more than thirty rural-delivery roads were inspected, in cooperation with the Post-Office Department, at a cost of only about $950 to this Department. Much improvement has resulted from these inspections.

Between August 17 and October 14, 1906, an engineer from the Office of Public Roads made an investigation of the roads and trails in the Yellowstone Forest Reserve upon request of the Forest Service. A report containing recommendations and estimates was prepared and submitted to the Forester.

The Department cooperated with the Navy Department in the construction of a shell road at the New Orleans naval station; with the War Department in experiments with dust preventives, and with the Geological Survey in designating on topographic maps the character of the roads shown.

INVESTIGATION OF ROAD MATERIALS IN THE SEVERAL STATES.

Previous to the past fiscal year no personal investigation of road materials in the several States had ever been made, owing to the magnitude of the work and lack of appropriation. Last year, however, a cooperative arrangement was entered into whereby the State highway commissioner of Minnesota was made a special agent of the Office and assigned to the work of investigating the road materials in that State. This work will be completed during the present calendar year. It is intended that such an investigation shall be conducted in each of the States as rapidly as facilities will permit. This investigation is

designed to ascertain the location, character, quality, quantity, and accessibility of all road materials in the respective States, cost of transportation by rail, by water, and by wagon, suggestions for possible methods of quarrying, probable markets for material, feasibility of using convict labor in the preparation of material, and other essential points.

MODEL COUNTY SYSTEMS.

The roads of a county should be built according to a predetermined and unified system, based upon a most careful investigation of materials, amount of traffic, revenue available, methods of construction adapted to local needs, organization and administration, and all factors entering directly or indirectly into the road work. A plan was inaugurated during the past year whereby the most competent engineers of the Office of Public Roads were assigned, upon request of county authorities, to make such an investigation and to prepare for the future use of the county road authorities an exhaustive and detailed report with plans, estimates, and recommendations indicating the location of all materials, advising which should be used, indicating the roads that should be improved and the method and cost of improvement suggested, needed changes in organization and in methods of administration, and in short affording a guide for future county road work.

The first assignment of this character was made at Santa Barbara, Cal., followed by work of a similar character in Los Angeles County. The success of this work has been recognized, and Los Angeles County is now proceeding under recommendations made by the engineer of this Department.

INVESTIGATION OF DUST PREVENTIVES AND ROAD PRESERVATIVES.

In recent years perhaps the most important and certainly the most difficult problem which has engaged the attention of highway engineers is the prevention of dust. Until the general introduction of motor vehicles dust was considered as neither more nor less than a nuisance. The problem has now, however, assumed a more serious aspect. The existence of our macadam roads depends upon the retention of the rock dust formed by the wearing of the surface. Under ordinary traffic conditions this dust remains on the road and consolidates to form a fresh wearing surface. But a heavy rubber-tired automobile moving at a high rate of speed produces a partial vacuum behind each wheel which sucks up the dust from the road surface and throws it into the air to be carried off by the wind. This action soon strips the macadam road of all fine material, the result being that it soon disintegrates.

France, both by reason of her large mileage of macadam roads and the general use of automobiles, has given this subject the earliest and most thorough consideration. Investigations and experiments have also been conducted in England, and to some extent in this country. During the past year a thorough investigation was made of the systems in use both in France and England. Experiments with tar and oil were conducted during the past summer in Kentucky and Massachusetts with a number of materials and preparations designed to preserve macadam road surfaces.

THE DEPARTMENT'S WORKING FORCE.

The report of the Appointment Clerk shows that there were on the rolls of the Department at the close of the fiscal year 9,107 employees. Of the entire force, 1,972 were employed in the District of Columbia and 7,135 outside of the District.

The following figures are sufficient to show the growth of the Department during the past forty years: In 1867 the total number of persons employed in the Department was 99; in 1877 the total number was 77; in 1887 there were 328 employees; by 1897 the number had increased to 2,444; and on July 1, 1907, the total number of persons employed had reached 9,107.

OFFICE OF THE SOLICITOR.

Questions affecting the operations of the Department under the statutes committed to it for execution were frequently referred to the Solicitor during the year for written or oral opinions, and several important confidential investigations of a quasi-legal character were conducted under the direction of the Secretary. The correspondence connected with the enforcement of the twenty-eight-hour law is very voluminous. There were 677 cases under this law transmitted to the Department of Justice during the year. Eight cases under the Lacey Act (act of May 25, 1900) regulating interstate commerce in game were reported to the Department of Justice. The Department secured a conviction in the only case reported under the act of June 28, 1906, prohibiting trespass upon the bird reserves set apart for its use by orders of the President. Recovery of property of the Weather Bureau withheld by former employees was effected through the Solicitor in the three cases reported by the Bureau. In a number of cases pending in the Court of Claims at the close of the year the Solicitor assisted the special attorneys for the Government in procuring the evidence and preparing the papers. During the year the Department secured a conviction under the cattle quarantine law (act of May 29, 1884), and reported a number of cases to the Department of Justice, which are now pending. Under the cattle quarantine act of March 3, 1905, three convictions were secured in cases reported by the Department. Several others are pending. In addition to these cases there were 215 complaints against railroads for violation of the regulations of the Department governing the placarding of cars in interstate shipment of cattle from quarantined area investigated by the Solicitor and taken up by him with the respective railroads with a view to securing a rigid compliance with the regulations in the future. The meat inspection amendment of June 30, 1906, went into force in October of that year. One case had been reported to the Department of Justice before the close of the fiscal year. In December the Department secured the conviction of a man who attempted to bribe a live-stock inspector, and he was fined $300 and sentenced to ten days in jail. The meat-inspection amendment of June 30, 1906, imposes upon the Secretary the duty of prescribing regulations for its enforcement. In this work the Solicitor rendered assistance, as well also as in the preparation of the decisions announced by the Department in its interpretation of the food and drugs act. Three patents for Department employees were procured during the year, and others applied for. The Solicitor is one of the three members of the Board

of Food and Drug Inspection, in which capacity much of his time is spent. He is likewise a member of the committee on personnel of the Department for the investigation of all serious delinquencies occurring among the employees thereof.

NEW BUILDING FOR THE DEPARTMENT.

The work on the new building for the Department has progressed satisfactorily during the year, and it is hoped to occupy the new quarters within the next month or two. As pointed out in my last report, in considering the question of a building, the imperative need for suitable laboratories to carry on the important investigations of the various bureaus and fireproof space for the library was recognized as paramount. The greater part of the indoor work of the Department is conducted in laboratories, hence the absolute necessity for structures that would be well lighted, well ventilated, fireproof, and otherwise well adapted for the purpose. To accomplish these several objects and at the same time to secure opportunities for continued enlargement, the building has been arranged so that extensions could be made in segments as the work required.

When the act authorizing the building was passed we could not foresee the rapid growth, by Congressional action, of the Department. On February 3, 1903, when the work was authorized, there were in Washington 1,100 persons employed in the Department of Agriculture. At the present time there are over 2,100—almost double the number on the date when the appropriation was made.

While the original appropriation was so expended as to secure the greatest possible amount of floor space, this floor space is now totally inadequate to care for the increase of almost 100 per cent in the number of employees. Full arrangements have been worked out for the occupancy of the present segments and the relinquishment of the several buildings for which rent is now being paid. The work will be completed within the appropriation made by Congress.

Details of the work of the Department are contained in the accompanying reports of the various Bureaus, Divisions, and Offices, the publication of which in connection with this report is respectfully recommended.

Respectfully submitted.

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C.,
November 23, 1907.

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